CHAPTER 3

NATURAL RESOURCES

3.1 PHYSICAL ENVIRONMENT

3.1.1 Climate

The Base has several climatic zones that roughly coincide with the three geomorphic regions present: coastal plain, coastal valley, and mountain. In general, the Base has a semiarid Mediterranean climate with warm, dry summers and mild, wet winters. Daytime temperatures rarely exceed 95º F in the summer and nighttime temperatures usually remain above freezing in the winter.

Seasonal rainfall along the coast averages between 10 and 14 inches per year. Average annual precipitation in the mountains varies between 20 and 40 inches, depending upon slope and elevation. Approximately 75% of the Base's precipitation falls between November and March. Winds generally originate from the west or southwest, carrying in cool, moist offshore air.

Night and early morning clouds throughout the spring and summer characterize the region. Low clouds frequently extend inland over the coastal foothills and valleys but usually dissipate during the morning. Afternoons are generally clear. Coastal fog averages 29 days per year, being heaviest during the fall and winter months.

An important characteristic of local weather is its year-to-year variability. The native vegetation is adapted to periodic drought and flooding. Erosion and sedimentation patterns are influenced by this variability, with most soil loss occurring perhaps once in every 20 years. The pattern of winter storms determines whether there is enough antecedent soil moisture before an intense storm to cause significant soil loss. Intense storms have little impact if the soil is dry enough to absorb water quickly.

"Fire weather" occurs from May through November, with extreme fire conditions occurring when very dry, warm "Santa Ana" winds blow when vegetation is dry and soil protective cover is low. These conditions sometimes result in high erosion rates when intense storms follow a hot fire. Camp Pendleton's geography exacerbates the problem because its northeast-southwest trending canyons are able to pull in marine air each day as land surfaces heat up, creating up-canyon winds. At night, the breezes are pulled back down-canyon and seaward as land surfaces cool (MCB Camp Pendleton 1992).

Local weather and stream gauge data are collected from six stations within the vicinity of the Base: Case Springs, San Mateo Canyon at Tate Grade, Cristianitos, Las Flores, Lake O'Neill, and Range 408. The Cleveland National Forest (El Carrizo Station) and the National Weather Service (Oceanside and San Clemente) also maintain records.

3.1.2 Topography

Camp Pendleton lies within the Peninsular Range of the southwestern geographic region of California. The massive Peninsular Ranges complete the coastal mountain system of California, extending south from the Los Angeles Basin to the tip of the Baja Peninsula, and include the steep, narrow, and northwest trending San Jacinto, Santa Rosa, Agua Tibia, and Laguna Mountains that plunge into the Coachella and Imperial valleys.

The terrain of the Base is varied and includes sandy shores and seaside cliffs, coastal plains and rolling hills, canyons, and mountains rising to elevations of nearly 2,700 feet. Northeast of the coastal hills, the Santa Margarita Mountains average between 1,500 feet and 1,720 feet in elevation. Two major physiographic provinces occur on Base: coastal plains, which rise steeply from the coast inland into fairly level terraces, and the rolling foothills of the Santa Margarita Mountains. The break between these two provinces occurs generally along Basilone Road.

Characteristic of the Peninsular Range, natural erosion over time has formed a series of southwest trending stream valleys across the generally northwest-trending hills and mountains. Each stream has developed its own valley fill deposits, including an alluvial fan at its mouth near the coastline. The marine terraces inland from the coast slope uniformly to the southwest at inclinations of 5% or less. A majority of the Base exceeds 15% slope (Figure 3-1).

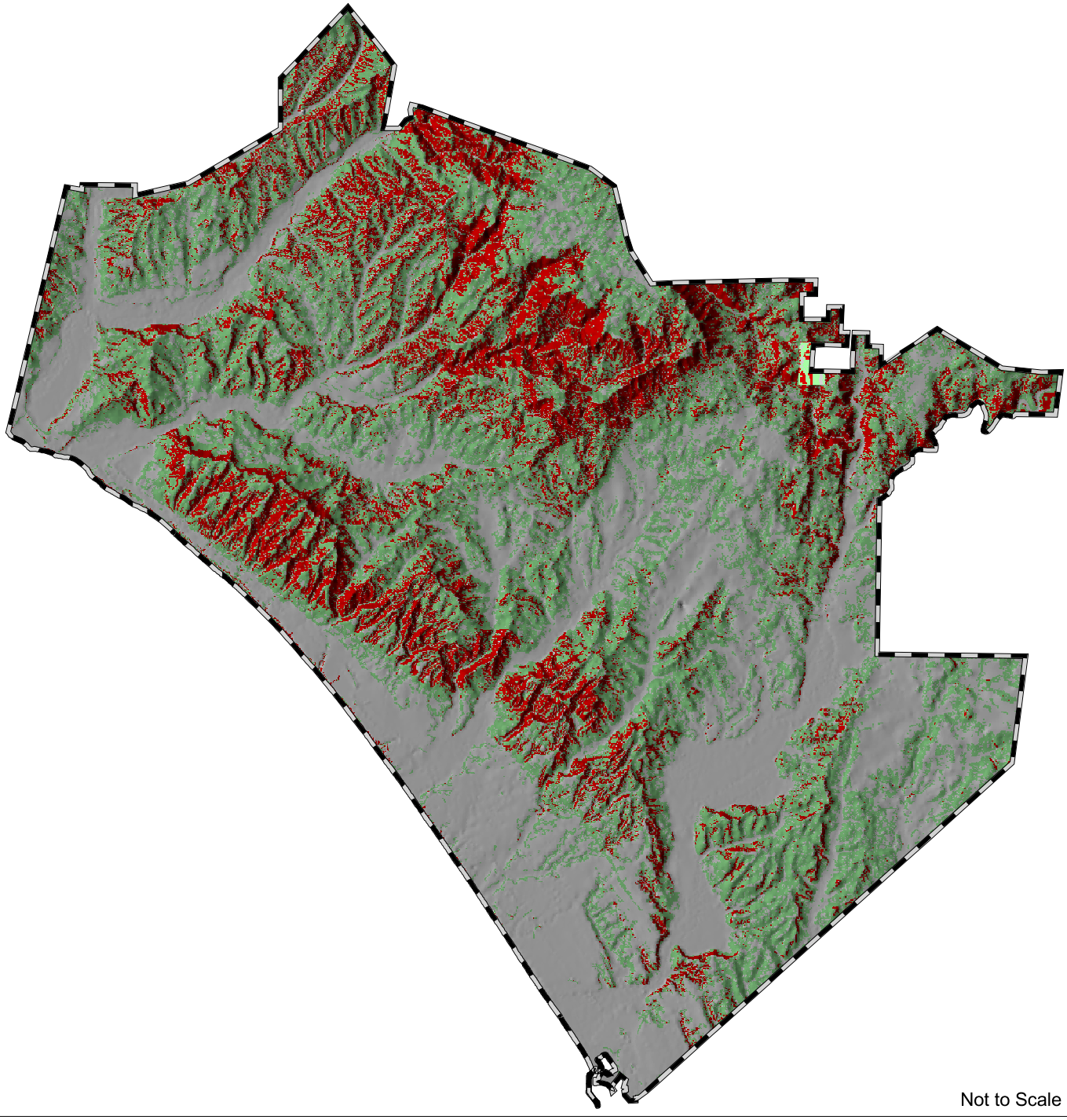
Part of the coastal area consists of steep, low hills that are dissected by the major stream systems of the Base. These are known as the San Onofre Hills. The highest elevation of the range is 1,720 feet, atop San Onofre Mountain. Other areas contain low, wave-cut terraces (mesas) that have distinct cliffs or escarpments along the seaward edge.

East of the San Onofre Hills is gently rolling topography with soils deep and level enough to support some agriculture. They give rise to the Santa Margarita Mountains, part of the Peninsular Range that extends from Orange and Riverside counties to the Mexican border. Margarita Peak, at 3,189 feet, is east of the Base and about ten miles inland from the coast.

3.1.3 Geology and Soils

Camp Pendleton contains diverse geological units, ranging from the oldest metavolcanic rocks and granite of the southern California Batholith to stream- or ocean-cut terrace sequences and recent alluvium. In general, the Base is underlain by Holocene to late Pleistocene (recent to 1 million years before present [mybp]) unconsolidated sedimentary deposits that include alluvium in canyon bottoms and coastal terraces, Eocene to Pliocene (2 to 55 mybp) sedimentary rocks of marine and non-marine origin, and Cretaceous to Triassic (63 to 240 mybp) bedrock that includes highly consolidated and cemented sedimentary rock and plutonic and metamorphic crystalline rock.

Landslides are widespread on Base, particularly within the San Mateo and Cristianitos watersheds, and vary in size from less than an acre to more than a square mile (Blanc &



Not to Scale

Figure 3-1
Slope / Topography

Camp Pendleton Boundary

0 - 15% Slope

16 - 30% Slope

> - 30% Slope

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Map Source:
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Cleveland 1968, as cited in MCB Camp Pendleton 1997). This activity is partly due to steep slopes, cover, and climate.

Over fifty soil types are found on Camp Pendleton (Figure 3-2; Appendix L). Soil parent material on the coastal plain consists mostly of poorly consolidated marine sediments, while foothill soils are granitic with some metasedimentary and metavolcanic inclusions. A detailed description of Base soils can be found in the San Diego County Soil Survey (U.S. Soil Conservation Service 1973). The level of resolution for Soil Survey maps is appropriate for preliminary planning purposes only. For activities where soil properties are important, such as construction projects, testing should be done to confirm the nature of the soil on site.

3.1.4 Hydrology

The hydrology of Camp Pendleton is influenced by several factors, including those that are natural (topographic, geologic, climatic, etc.) and human influenced (land use, dams, etc.). Proper management and stewardship of water resources are fundamental to natural resource and land use sustainability. This section provides a cursory overview of fundamental hydrologic features that characterize Camp Pendleton, including watersheds, precipitation, and runoff. Also introduced in this section is Camp Pendleton's water quality, supply, and use.

3.1.4.1 WATERSHEDS

Mountain ranges divide the Base into four main watersheds, or drainage areas (Table 3-1, Figure 3-3): Santa Margarita, Las Flores, San Onofre, and San Mateo. The Las Flores watershed is often divided into subsidiary watersheds, the Las Flores, Coastal, and Aliso. Although the San Louis Rey River drains into the ocean south of the Base, a fraction of this watershed occupies the southern portion of the Base.

The largest drainage, the Santa Margarita, is 742 square miles (474,880 acres). Over 90% of this watershed is off-Base lands. De Luz Creek is an important tributary to the Santa Margarita. Some areas south of the Santa Margarita River drain off Base into the San Luis Rey River. Aliso Creek, Horno Creek, French Creek, Cockleburr Creek, Hidden Creek, Las Flores (with tributaries Las Pulgas and Piedra de Lumbre), and San Onofre Creek (and the Jardine Canyon tributary) are watersheds that are completely on Camp Pendleton and drain into the Pacific Ocean. San Mateo Creek drainage with tributaries Cristianitos and Talega includes areas of the Cleveland National Forest, San Onofre State Park, the City of San Clemente, and other private lands.

The two largest watersheds on Base, Santa Margarita and San Mateo, form broad alluvial plains as they approach the Pacific Ocean. As the streams reach the sea, sloughs or estuarine lagoons form due to sand bars or narrow tidal barriers. These impound low stream flows but are breached during high flows caused by storm events. The blockages subsequently reform by sedimentation and normal wave action. The three largest estuaries on the Base are situated at the mouths of the Santa Margarita, Las Flores, and San Mateo streams.

TABLE 3-1. Principal watersheds: acreage and percent occupation occurring on Camp Pendleton. [a]

Watershed	Approximate Acreage on Base	Approximate Total Acreage of Watershed	Percent of Watershed on Base
Aliso	11,400	11,400	100
Coastal	9,800	9,800	100
Las Flores	16,900	16,900	100
San Luis Rey	9,100	357,120	2
San Mateo	18,200	87,680	21
San Onofre	27,520	27,520	100
Santa Margarita [b]	31,200	474,880	7

[a] Only the major watershed groups are presented (several smaller systems may be lumped into a single watershed system).

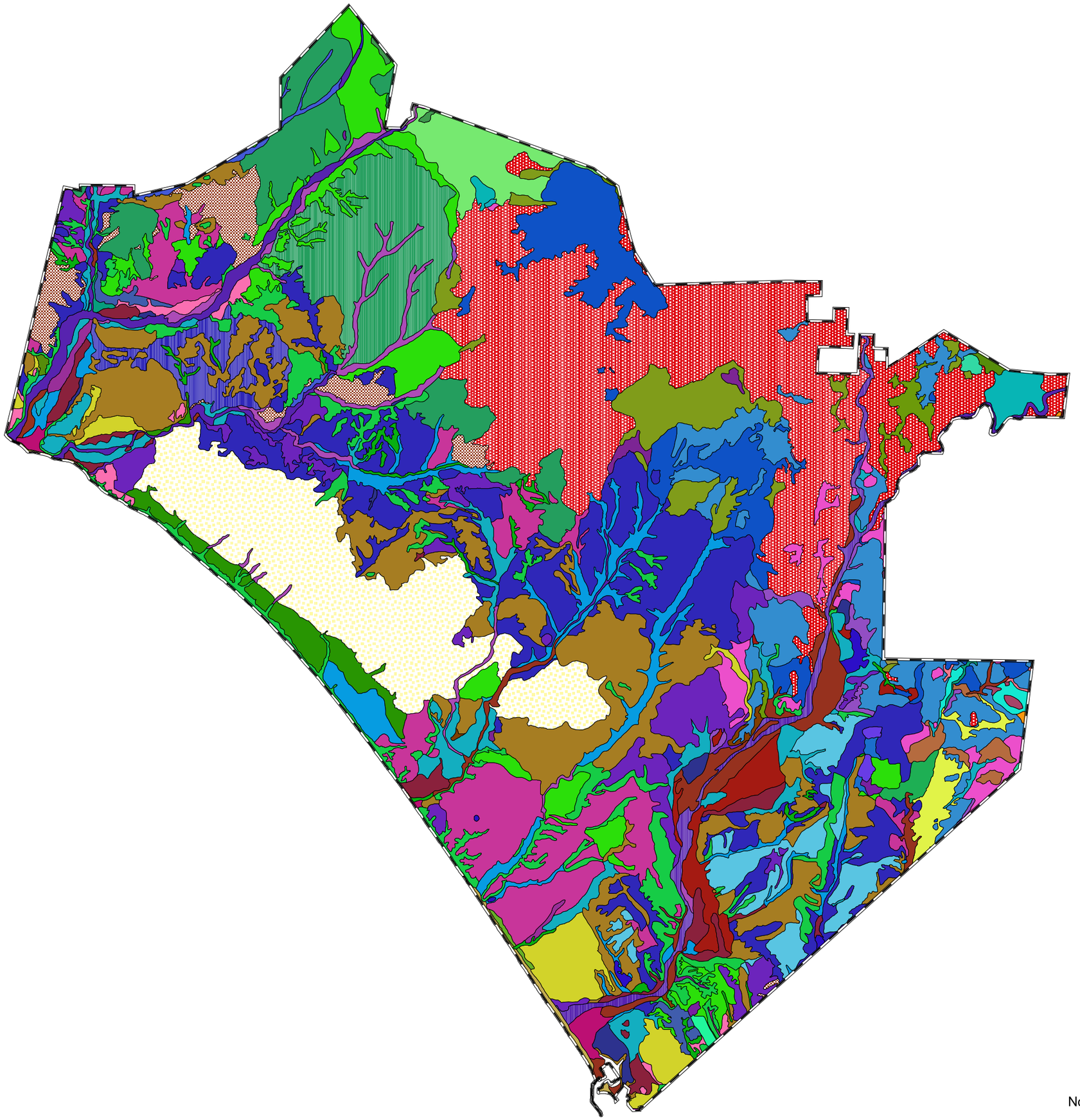
[b] Santa Margarita watershed acreage includes the southernmost portion of the Deluz Creek watershed which occurs on Base.

Headwaters for the four main watersheds of Camp Pendleton originate on the western slopes of the Peninsular Ranges. Flowing southwesterly to the Pacific Ocean from the Santa Ana and Santa Margarita Mountains and the Santa Rosa Plateau is the largest stream system, the Santa Margarita River. Below the confluence of Murrieta and Temecula Creeks, the Santa Margarita is southern California's only "free-flowing" river with no major dams. Activities of the nonmilitary ownership of these drainages (Table 3-1) affects water quality and sedimentation issues for the Base.

The two smaller watersheds to the north, San Onofre and Las Flores, are completely contained within the Base. Las Flores Creek is formed less than a mile from the Ocean where Las Pulgas Creek and Piedra de Lumbre Creek come together. At the most northern portion of the Base is the San Mateo Creek watershed.

The alluvial valleys in the lower portions of these four watersheds contain the principal source of water for the Base (MCB Camp Pendleton 1986). These groundwater basins were evaluated for their "safe yield" of potential water, which is the amount of groundwater that can be extracted without detrimental effects to the basin (Leedshill-Herkenhoff 1989). All of the Base's well production in the Santa Margarita River watershed is from the younger alluvium (Jenks 1993).

Figure 3-2
Soil Types



Not to Scale

Camp Pendleton Boundary

- Acid igneous rock land
- Altamont clay
- Blasingame loam
- Bonsall sandy loam
- Bosanko clay
- Carlsbad gravelly loamy sand
- Carlsbad-Urban land complex
- Chesterton fine sandy loam
- Cienaba coarse sandy loam
- Cieneba rocky coarse sandy loam
- Cieneba very rocky coarse sandy loam
- Cieneba-Fallbrook rocky sandy loams
- Coastal beaches
- Diablo clay
- Diablo-Olivenhain complex
- Elder shaly fine sandy loam
- Escondido very fine sandy loam
- Exchequer rocky silt loam
- Fallbrook rocky sandy loam
- Fallbrook sandy loam
- Fallbrook-Vista sandy loam
- Friant rocky fine sandy loam
- Gaviota fine sandy loam
- Grangeville fine sandy loam
- Greenfield sandy loam
- Hambright gravelly clay loam
- Huerhuero loam
- Huerhuero-Urban land complex
- Las Flores loamy fine sand
- Las Flores-Urban land compex
- Las Posas fine sandy loam
- Las Posas stony fine sandy loam
- Linne clay loam
- Loamy alluvial land-Huerhuero complex
- Made land
- Marina loamy coarse sand
- Olivenhain cobbly loam
- Olivenhain-Urban land complex
- Placentia sandy loam
- Placentia sandy loam, thick surface
- Ramona gravelly sandy loam
- Ramona sandy loam
- Reiff fine sandy loam
- Riverwash
- Rough broken land
- Salinas clay
- Salinas clay loam
- Steep gullied land
- Stony land
- Terrace escarpments
- Tidal flats
- Tujunga sand
- Visalia gravelly sandy loam
- Visalia sandy loam
- Vista coarse sandy loam
- Vista rocky coarse sandy loam
- Water

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Map Source:
AC/S Environmental Security
GIS Branch
October 2001

Integrated Natural Resources Management Plan

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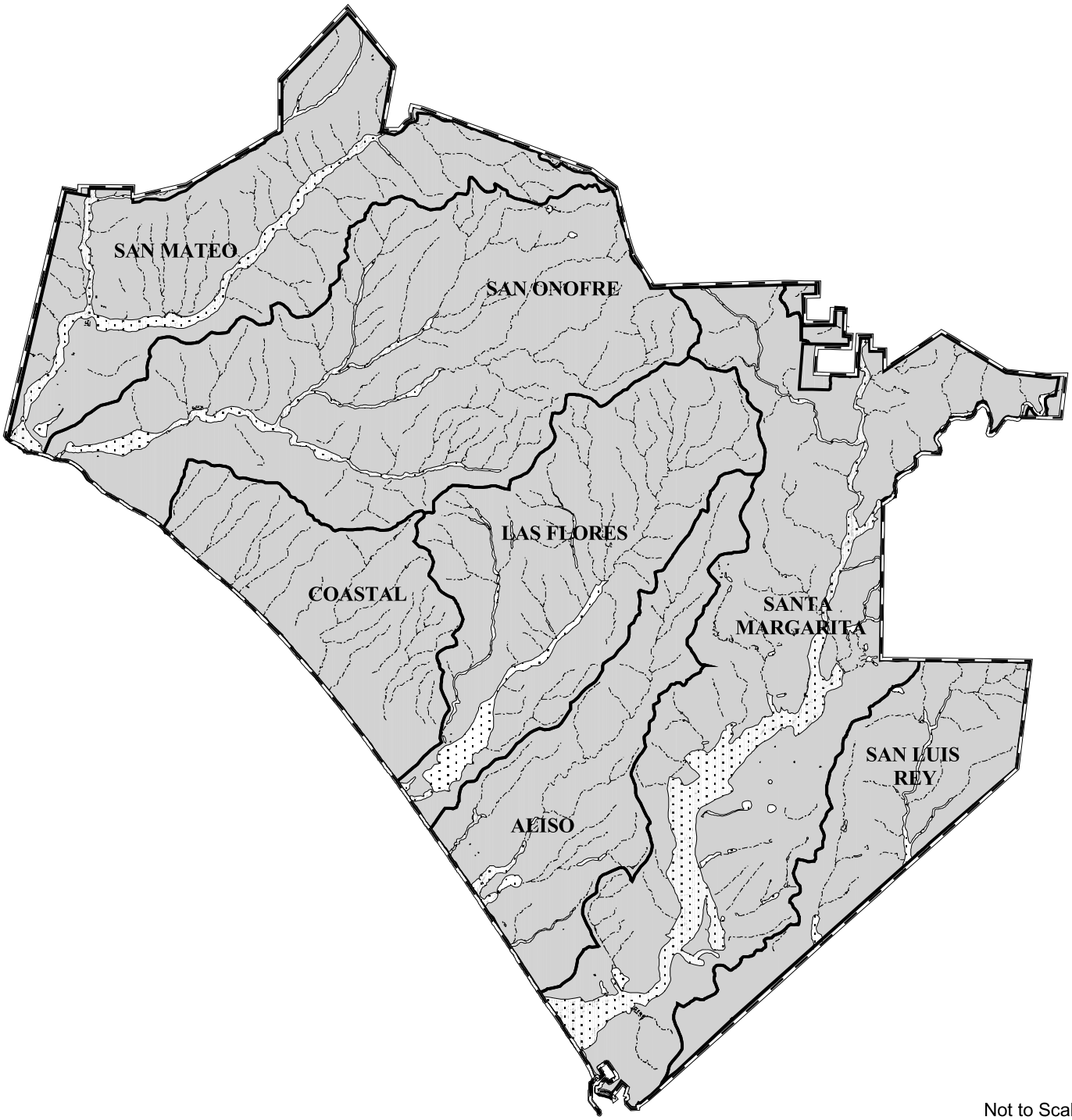

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Figure 3-3
Watersheds

Camp Pendleton Boundary

Streams (USGS)

Watershed Boundary

Riparian, Beach & Estuarine Habitats

Upland Habitats

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Map Source:
AC/S Environmental Security
GIS Branch
October 2001

Integrated Natural Resources Management Plan

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3.1.4.2 PRECIPITATION AND RUNOFF

Over one hundred years of precipitation records (up to 1990) for the lower area of the Base (Table 3-2) reveal an average of 13.47 inches of precipitation per year, with a minimum of 4.51 inches (in 1960-61) and a maximum of 34.40 inches (1977-78). However, in 1993, a year with serious flooding, rainfall was estimated to have reached 42.0 inches (Malloy, pers. comm. 1994). In the mountains at Case Springs (at 2300 ft. elevation), the 1965-1993 records indicate an average precipitation of 23.02 inches, with a minimum of 10.05 (1980-81) and a maximum of 50.42 inches (1968-69).

The variability in annual runoff for the major streams on the Base is shown in Table 3-2 below. Discontinuous collection of flow data, however, hinders the accuracy of some of these historical records.

The potential is particularly high for large floods on Camp Pendleton because of the extreme variability of runoff and precipitation. Successive soil-saturating storms in early 1993, combined with intense rainfall (6.8 inches in 24 hours) in the upper watershed, led to record flooding in the Santa Margarita River on January 16. At the damaged gaging station at Ysidora, the estimated peak discharge of 45,000 cubic feet per second (cfs) was the highest in 68 years of record keeping, exceeding the previous record (February 16, 1927) by about 12,000 cfs or 34% (Bowers 1993).

TABLE 3-2. Recent hydrologic records for gaging stations on or near Camp Pendleton.

Stream Gage Station	Period of Record (water year or month/year)	Minimum Runoff (acre-feet)	Maximum Runoff (acre-feet)	Average Runoff (acre-feet)
San Mateo Creek near San Clemente [a]	1953 - 76; 1990 - 1993	13	62,699	8,230
Santa Margarita River near Fallbrook [b]	10/24 - 1/80; 9/89 - 9/93	1,410	159,000	19,940
Santa Margarita River at Ysidora [b]	3/23 - 9/93	0	244,400	25,012
De Luz Creek near Fallbrook [a,b]	2/51 - 9/76; 9/89 - 9/93	0	31,286	3,970
Fallbrook Creek near Lake O'Neill [a]	10/64 - 9/76; 10/89 - 9/93	32	6,247	1,491
San Onofre Creek at San Onofre [a,b]	1952 - 1976;	0	14,684	1,581

[a] AC/S Environmental Security records, Camp Pendleton.

[b] U.S. Geological Survey records. (Several of the active gage stations were temporarily out of commission as a result of the January 1993 flood and flows were estimated in the interim.)

The 100-year peak flow at this gage station is estimated (for flood control purposes) to be 100,000 cfs (assuming upstream storage sites are full), with a total five-day flood volume predicted to be 144,000 acre-feet (Leedshill-Herkenhoff 1989). Peak discharges will likely increase in future years due to the effects of expanded urbanization in the upper watershed.

During the summer months, the frequency of extremely low flows in unregulated streams is particularly high throughout Camp Pendleton. It is not unusual for the San Mateo, San Onofre, and Los Flores Creeks to be dry from July through October. The Santa Margarita River has had no flow reaching the Ocean during about 26% of the period of record (Leedshill-Herkenhoff 1989).

3.1.4.3 FLOODPLAINS AND SURFACE WATERS

A flood evaluation completed in 1989 concluded that, under existing conditions, the 100-year flood would inundate almost all of the developed areas near the Santa Margarita River, except the Naval Hospital, Sewage Treatment Plant No. 3, and the Ranch House. This flood channel is about 1000 feet wide, compared to a low flow channel of less than 100 feet, and covers most of the valley floor where the River traverses the Base (Leedshill-Herkenhoff 1989).

Severe channel-bed scour to a depth of at least 10 feet below the riverbed had previously removed one of the Basilone Road bridge footings during a 21,200 cfs flood in the winter of 1978 (Chang 1988). Before the January 1993 flood, it was predicted that the existing bridges at Basilone Road and Stuart Mesa Road would be overtopped by a 100-year flood at 100,000 cfs and that a non-damaging flood would have to be less than 11,000 cfs (Leedshill-Herkenhoff 1989). The 1993 flood of an estimated 45,000 cfs at Ysidora was about a 25-year flood event (based on the most recent flow frequency table). It destroyed the bridge at Basilone Road and damaged the Stuart Mesa Road Bridge.

Damage was exacerbated in 1993 because immense amounts of sediment and debris, estimated at 300,000 cubic yards and largely from off-Base sources, were deposited on the wide, flat floodplain of the Santa Margarita River, as the flood passed through Camp Pendleton (California Regional Water Quality Control Board 1993). In addition to the loss of bridges, railroad tracks were washed out and the Air Station was severely impacted by sedimentation. Drinking water quality was in question as a result of the flood's impact on the water supply wells within the floodplain and some of the sewage treatment plants were flooded and retention ponds destroyed.

Concern has been raised that more frequent and damaging flood events could be experienced on the Base because of the effects of increased upstream urbanization in the Santa Margarita Watershed. Previous damaging floods have occurred at Camp Pendleton in 1951-52, 1956, 1968-69, 1978, and 1980 (Leedshill-Herkenhoff 1992).

While two major dams, at Vail Lake and Skinner Reservoirs, are located far upstream in the Santa Margarita watershed, Camp Pendleton has only a low flow impoundment on this river that is used to divert water into Lake O'Neill. This small lake was constructed originally in

1883 on Fallbrook Creek (a tributary) to store water for farm irrigation. Since it came into use for the Base, the lake's purpose has been primarily to supplement the water supply and secondarily to provide recreation. This reservoir has a capacity of 1,200 acre-feet and is dependent on the Santa Margarita River (through the O'Neill Ditch diversion), Fallbrook Creek, and rainfall runoff as its water sources. To help recharge downstream aquifers, its stored water is released each fall into percolation ponds near the gaging station (Leedshill-Herkenhoff 1989).

In addition, small ponds are located throughout the Bas, including: Case Springs and Witman Pond (both in San Onofre watershed); Pulgas Lake (Las Flores watershed); Broodmare Pond, Pilgrim Creek Pond, Horseshoe Lake, and Windmill Lake (San Luis Rey watershed); Wildcat Ponds and India Ponds (all in Santa Margarita watershed).

3.1.4.4 WATER QUALITY, SUPPLY, AND USE

Frequent low flow conditions in the Base's streams can concentrate and exacerbate natural and human-caused water quality problems. While certain water quality objectives set by the State through the San Diego Regional Water Quality Control Board have sometimes been exceeded, the quality of Camp Pendleton's drinking water presently meets the mandatory health-related standards established by the California Department of Health Services under Title 22 of the Health and Safety Code (MCB Camp Pendleton 1993a).

Data from surface water quality monitoring stations indicate that the Santa Margarita River's water contains excessive total dissolved solids (TDS) and nitrate, and increasing concentrations of magnesium and sulfate. Groundwater quality in the Base's wells near this river is impacted by TDS levels above California water quality objectives and threatened by increasing levels of nitrate, sulfate, and chloride (Leedshill-Herkenhoff 1989). Upstream users greatly affect the Base’s water quality since Camp Pendleton is the last water user on the extensive Santa Margarita River system. Nutrient levels, particularly nitrogen, have increased in recent years due to intensive agricultural use of fertilizers in the upper watershed. In addition, a dramatic expansion of residential, commercial, and industrial development during the past decade in the upper part of the drainage has produced more urban runoff and wastewater discharge.

For the other three major drainages on the Base, fewer sampling data are available. However, surface water samples indicate that Las Flores, San Onofre and San Mateo Creeks all have had TDS levels that at some point exceed the Regional Water Quality Control Board's objectives. San Mateo Creek's quality also exhibits excessive sulfate and nitrate concentrations. While drinking water standards for groundwater are met for most constituents in the three drainages, recurring problems have been noted for TDS, conductivity, nitrate, iron, sodium, and coliform (*E. coli*). Data have not indicated any long term trends. (Leedshill-Herkenhoff 1989).

Concern is always present about potential seawater intrusion into the Base wells if the water extraction exceeds the safe yield of the individual basins (MCB Camp Pendleton 1986). Frequent monitoring and extraction control of key wells appears to have helped prevent such

contamination from occurring in recent years. Historically, however, the Ysidora Narrows well in the Santa Margarita River Basin showed evidence of seawater advance as far as 3 miles upstream by 1952 due to pumping in the basin (California Department of Water Resources 1956). By maintaining a five foot level static water level at this critical well site, seawater intrusion has apparently been avoided. Increased chloride concentrations at this site and at a well in the San Onofre Creek Basin may have also been caused by increased pumping from lower quality strata and decreased fresh water recharge (Leedshill-Herkenhoff 1989). Salt-load imbalances in each of the groundwater basins was noted to have increased dramatically from 1964 to 1976 and were projected to increase in Santa Margarita Basin due to further development upstream (PRC Engineering, Inc. 1983).

Excessive levels of sediment, particularly in the Santa Margarita River, are another water quality problem. Until the 1993 flood, studies had predicted that the Santa Margarita would be a low sediment producer due to its lower average rainfall and higher percolation rates compared to other large rivers in the region (Brownlie & Taylor 1981). In January 1993, intensive rainfall in the headwaters, combined with over 5,000 acres of bare ground from unfinished and unprotected construction sites, helped yield a river of "liquid sandpaper" which scoured channels and left four- to eight-foot deposits of sand and gravel in the Camp Pendleton floodplain and estuary, despite several upstream dams trapping sediment (California Regional Water Quality Control Board 1993; Bell 1993).

Hazardous waste contamination has been detected in soil and shallow groundwater on the Base but not in the deep aquifer supplying drinking water. Groundwater monitoring reveals that no contamination has migrated off the Base's property. In 1989, Camp Pendleton was placed by the U.S. EPA on the National Priorities List for cleanup of hazardous waste. Contamination is from solvents, metals, petroleum, and other wastes contributed by past waste handling and disposal practices on the Base. A cleanup program is currently in operation (MCB Camp Pendleton 1993b).

Camp Pendleton's domestic, agricultural, and industrial water supply is totally dependent on pumping from underground aquifers located on the Base that are recharged by percolation from overlying rivers and streams. At present, Camp Pendleton does not rely on imported water, unlike most other water systems in Southern California.

Santa Margarita River wells provide water to the Headquarters Area, Naval Hospital, Camp Del Mar, and all points in-between, representing about 65% of the total water consumed on the Base. The Las Flores Creek wells produce water for Camp Pulgas and Camp Las Flores, while the San Onofre Creek well water is delivered to Camp Horno and Camp San Onofre. Camps Talega, Cristianitos, and San Mateo; the San Onofre Housing, School, and Trailer Park; and the 51 area Marine Corps Exchange complex are all served by wells from San Mateo Creek (MCB Camp Pendleton 1993a). Agricultural wells supply irrigation water for leased sites of about 700 acres in the Stuart Mesa area and 600 acres in the San Mateo area.

Since complete well production records began in 1944, total annual water use has ranged from a low of 5,850 acre-feet (1991) to a high of 10,656 acre-feet (1979). While total use averaged 8,066 acre-feet over this 50-year period, well production during 1991-1993 was significantly lower, averaging 6,311 acre-feet, or a 22% reduction. Military consumption

represents an annual average of 5,910 acre-feet (73% of the total), while agricultural irrigation use (on leased sites) amounts to 2,156 acre-feet (27%). Fluctuation in use is related to water conservation efficiency during drought years, troop mobilization levels, water system leaks, crop water needs, and other factors.

3.1.5 Fire

Fire has a strong influence on the biological structure and composition of Camp Pendleton's vegetation. It can play a positive, even necessary, role in the maintenance of native vegetation and natural community structure. Fires can create a mosaic of seral stages within a particular vegetation community that promotes habitat diversity. However, the fire frequency at some locations on Camp Pendleton is higher than other areas in southern California (MCB Camp Pendleton 1998). A high fire frequency can permanently change the vegetation type (type conversion) of a given site by suppressing it to a lower seral stage. The use of pyrotechnics and live-fire ammunition by the military during training creates this additional risk of fire occurrence relative to other areas of southern California.

Zedler et al. (1997) states that anthropogenic causes of fire in southern California are not a recent phenomenon. In fact, it appears that prehistoric humans played an active and significant role in elevating fire frequency (Zedler et al. 1997). Early native Americans, as well as the Spanish and Mexican settlers of the region, regularly used fire as a tool to clear brush to facilitate hunting and to promote grazing (Rasmussen & Woodman 1997). Cattle grazing and, later, crop cultivation continued on the former *Rancho Santa Margarita y Las Flores* (now Camp Pendleton) until the U.S. Government acquired the land in 1942.

While fire ignitions and burn frequency at Camp Pendleton are much higher today than at the time the military acquired the property, burn patterns may reflect prehistoric ones more closely than those resulting from fire suppression policies in southern California (Minnich 1983). Vegetative, topographic, and climatic factors in the region have also favored fire since the emergence of the Mediterranean climate hundreds of thousands of years ago.

3.2 BIOLOGICAL ENVIRONMENT

Southern California is one of the most biologically diverse regions in the continental United States. It supports a variety of habitat types and contains the greatest number of plant and wildlife species identified by the federal government as threatened or endangered (Dobson et al. 1997). Natural resources on Camp Pendleton reflect the rich diversity of species and habitat types formerly present within the region. The great diversity and abundance of plant and wildlife resources on Camp Pendleton provide many ecological, aesthetic, recreational, and military values to the Base, its residents, and the general public.

This section provides an introduction to the diversity of plant and wildlife species (including descriptions of federally listed threatened and endangered species) found on Camp Pendleton. Plant communities are also introduced in this section; however, greater description of these is provided in Appendix M. A discussion of the value that vegetation and

land cover provide to the training mission of Camp Pendleton is also presented. Included in this section is also a discussion of the importance, and present situation, of landscape linkages and corridors.

Nomenclature used within this document follows CalFlora (2000) for plants, Holland (1986) for vegetation types (plant communities), and California Wildlife Habitat Relationships System (CDFG 1999) and the California Natural Diversity Database (CDFG 2000a) for amphibians, birds, mammals, and reptiles. References to basewide survey efforts assume exclusion of restricted areas (i.e., Central Impact Area for safety reasons) and, depending upon the species, may assume efforts were focused within areas of potential habitat (e.g., surveys for beach species are conducted within beach habitats).

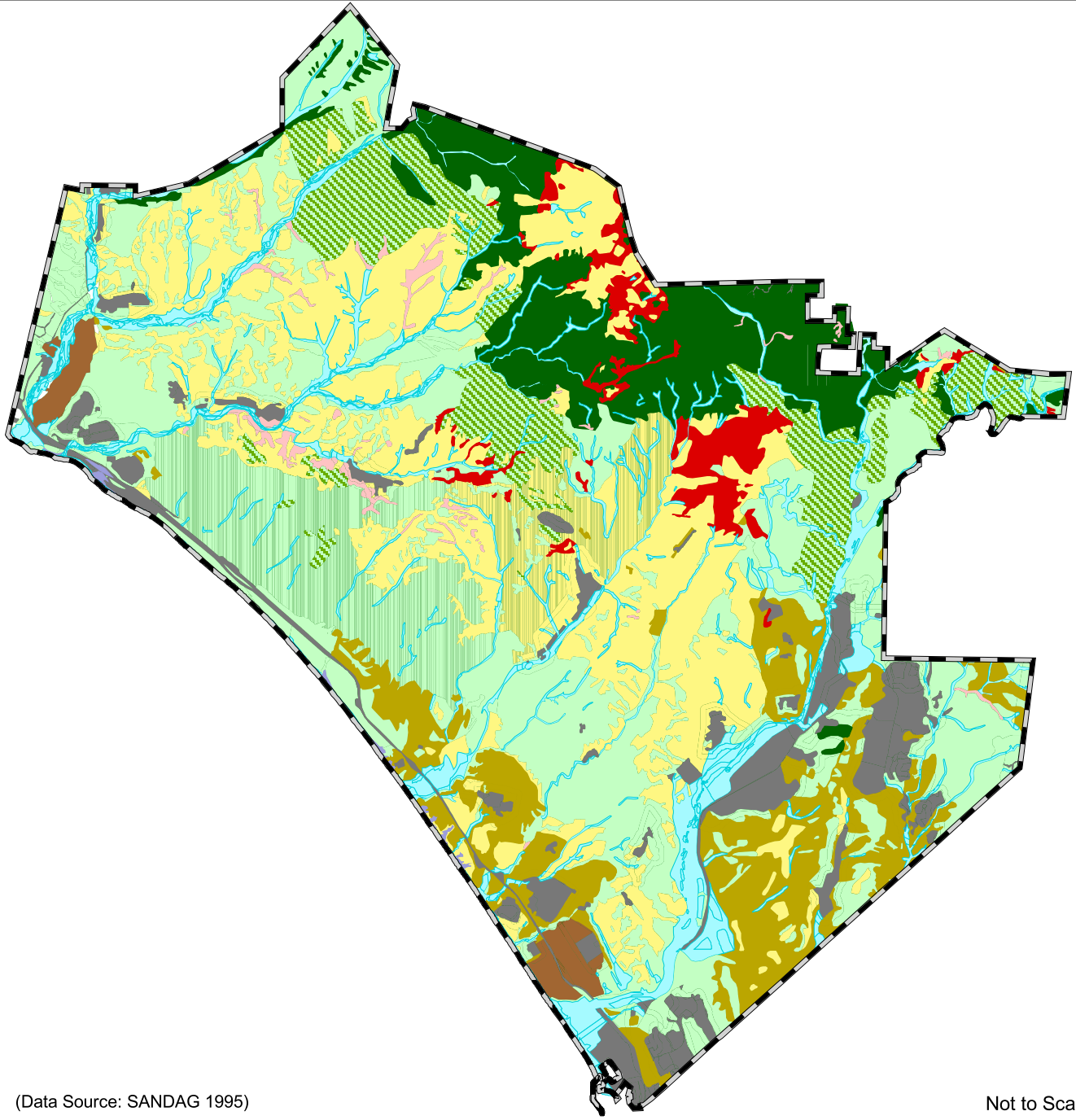
3.2.1 Plant Species and Communities

Camp Pendleton supports high quality, and in some instances, the last, remaining intact stands of sensitive habitat types in coastal southern California. Zedler et al. (1997) described and mapped 21 native and nonnative vegetation types on Camp Pendleton. Major vegetation types are presented in Figure 3-4 and descriptions are provided in Appendix M. Most of these vegetation types are recognized in the classification system developed by Holland (1986).

Rare plant surveys were first conducted on the Base in 1986 (PSBS 1986). Since then, additional rare plant surveys have been conducted in 1987 (PSBS 1987), 1988 (PSBS 1988), 1990 (PSBS 1990), 1993-1996 (Dudek & Associates 1993, 1996; Zedler & Bliss 1993), and 1997 (RECON 1999). Some of these surveys were conducted basewide, while others focused on selected portions of the Base. Over the years, approximately 818 plant species have been identified on Camp Pendleton (Table 3-3). A comprehensive plant list is presented in Appendix N. In addition to numerous rare plant species, three federally listed threatened or endangered plant species are known to exist on Camp Pendleton: thread-leaved brodiaea (*Brodiaea filifolia),* spreading navarretia (*Navarretia fossalis),* and San Diego button-celery (*Eryngium aristulatum* var. *parishii).* (See Section 3.2.3 for detailed descriptions of each federally listed species on Camp Pendleton.)

A number of rare and sensitive plant species that are known to occur in the region, including Encinitas baccharis and San Diego thornmint, have not been identified on Camp Pendleton to date. The Base will continue to look for and document occurrences of rare plants through basewide and project-level survey efforts.

Most of the plants on Base are considered native to the region, but as many as 20% (Table 3-3) are exotic (nonnative), often invasive species that in some cases have become naturalized since European settlement. These nonnative species are believed to have displaced some native plant species in the region. One historical account of the area (formerly *Rancho Santa Margarita y Las Flores*) from 1829 described wild (summer) mustard as a “terrible scourge” attaining heights of as much as three meters and claimed that it could not be controlled by human means or fire (Engstrom 1996).



(Data Source: SANDAG 1995)

Not to Scale

- Camp Pendleton Boundary
- Agriculture
- Coastal Bluff Scrub
- Coastal Sage Scrub
- CSS - Chaparral Mix
- Chaparral
- Coast Live Oak Woodland
- Englemann Oak Woodland
- Native Grassland
- Nonnative Grassland
- Riparian and Estuarine/Beach
- Developed Areas
- Disturbed/Ruderal

Figure 3-4
Major Vegetation Types

N

Map Source:
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GIS Branch
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Integrated Natural Resources Management Plan

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Some of the exotic invasive plant species that occur on Base include giant reed grass (*Arundo donax*), artichoke thistle (*Cynara cardunculus*), perennial pepperweed (*Lepidium latifolium*), mustard (*Brassica* spp.) fennel (*Foeniculum vulgare*), iceplant (*Mesembryanthemum crystallinum*), tamarisk (*Tamarix parviflora*), and tree tobacco (*Nicotiana glauca*).

TABLE 3-3. Number of native and nonnative plant species at Camp Pendleton, grouped by vegetation type.

Vegetation Type [a]	# Native Species	# Nonnative Species	TOTAL
Grasses	73	40	113
Vines	0	1	1
Ferns	20	0	20
Herbs [b]	409	103	512
Herb/Vine	17	2	19
Herb/Shrub	3	1	4
Shrubs	102	5	107
Shrub/Vine	4	0	4
Shrub/Tree	11	5	16
Trees	19	3	22
TOTAL	**658**	**160**	**818**

[a] Categories accommodate plant species that are classified as having more than one plant form (see Appendix N).

[b] Not including grasses.

3.2.1.1 USE OF VEGETATION COMMUNITIES BY MILITARY TRAINING

The diversity of natural vegetative cover enhances the realism of military training and is one of the reasons Camp Pendleton supports a wide variety of training. This section provides a summary of, the use of major vegetation types for military training.

Beach and Dune Communities

Beach communities are high value for training, due to the amphibious mission of the Marine Corps. Beach environments provide opportunities for amphibious landings. These landings involve simulating mine sweeps, securing defensive positions, and establishing encampments and staging areas ashore. In this type of training Marines learn to maneuver vehicles and equipment through the surf zone and wet and dry sand. Training activities at the Base's foredune community at White Beach and the Santa Margarita estuary have been restricted to protect nesting areas for the Federally endangered California least tern and the western snowy plover.

Shrublands (Includes Sage Scrub, Chaparral, and Bluff Scrub)

Shrublands can be difficult for wheeled vehicles and foot mobile troops to maneuver through and therefore provides valuable training opportunities in route selection and command and control. Vehicles and troops may have difficulty in traversing shrublands depending on terrain (which can be quite steep), size of vehicle, and density and size of the vegetation. In addition, shrublands provide good opportunities to practice concealment and camouflage skills since the vegetation is often not tall enough to hide a standing person or vehicle. Large areas of coastal sage shrublands are occupied by the federally threatened California gnatcatcher. This restricts activities year round that may impact habitat, and seasonal activities that may impact nesting birds.

Riparian

Military training in these areas is restricted due to wetlands regulations and the presence of endangered species. When available, riparian habitats provide realistic training for using covered and concealed avenues of approach for small units through the tall dense vegetation, mud and water. They are currently used to a very limited extent for foot activities.

Grasslands

Open grasslands are allow tracked and motorized units to fire and maneuver cross country. The terrain is usually flat to gently rolling and therefore provides many maneuver opportunities, as well as visibility for reconnaissance and observation for indirect fire.

Oak Woodlands

Oak woodlands provide excellent opportunities for concealment and camouflage. Sparse woodlands provide opportunities for mechanized units to maneuver whereas in more heavily forested areas these units are forced to use roads.

Coastal Salt Marsh

Military forces would seldom choose to advance through marshes if they could be avoided, because of the restrictions to movement imposed by the swampy conditions. Nevertheless these habitats provide training opportunities for military planners on how to avoid restrictive terrain.

3.2.2 Wildlife Species

Wildlife species on Camp Pendleton are important to the functioning of ecosystems and provide many benefits to humans. Some animals disperse seeds, while others consume

insects and rodents considered harmful to humans. Others provide recreational opportunities, such as hunting, fishing, and bird watching.

The large undeveloped portions of Camp Pendleton support a variety of wildlife species. In addition to hundreds of invertebrates, the Base has documented the presence of more than 50 mammalian, 30 reptilian, 10 amphibian, 300 avian, and 60 fish species (see Appendix O for list of wildlife species that have been seen on Camp Pendleton). Species of special concern that have been identified by various agencies and organizations are identified in Appendix O. Additional wildlife species certainly occur, but few financial resources are available to adequately survey for them, especially among the invertebrates.

Many wildlife species are resident on the Base and can be found throughout the year. While other wildlife species visit the Base seasonally, such as migratory birds like the least Bell's vireo, or periodically, such as the mountain lions and golden eagles that come and go as they travel throughout their large home ranges.

Most of the wildlife species on Base are considered native to the region, but many are also exotic. As with the plants, some exotic wildlife species are invasive and may be causing the decline or local extirpation of native species (e.g., as a result of competitive exclusion, habitat alteration, predation, nest parasitism, etc.). Examples of nonnative wildlife species on Base include the beaver (*Castor canadensis*), brown-headed cowbird (*Molothrus ater*), bullfrog (*Rana catesbeiana*), red swamp crayfish (*Procambarus clarkii*), Argentine ants (*Iridiomyrmex humilis*), and several exotic fish species (e.g., mosquitofish [*Gambusia affinis*], carp [*Cyprinus carpio*], black bullhead [*Ameiurus melas*], and green sunfish [*Lepomis cyanellus*]).

Among the many native wildlife species for which Camp Pendleton provides habitat are 2 mammalian, 1 amphibian, 8 avian, 2 fish, and 2 invertebrate federally listed threatened or endangered wildlife species (see Section 3.2.3 for a description of each species). A number of other federally listed threatened or endangered wildlife species are known to occur in the region, such as the quino checkerspot butterfly, but have never been identified on Camp Pendleton. Other federally listed threatened or endangered wildlife species, such as the red-legged frog, have been historically recorded on Base, but not in more recent survey efforts. A majority (91 %) of avian species on Base are included on the list of migratory birds (50 CFR 10.13) protected by the Migratory Bird Treaty Act and Executive Order (EO) 13186.

Five California listed threatened and endangered species and over 55 California listed Species of Special Concern are also found on Camp Pendleton. Included in these are: the Swainson's Hawk (California threatened); Western Yellow-billed cuckoo (California endangered) also recently added as a federal candidate species; Belding's Savannah Sparrow (California endangered); Peregrine Falcon (California endangered) recently delisted by USFWS; Bank Swallow (California threatened); Two-striped Garter Snake (California protected); Southwestern Pond Turtle (California protected); San Diego Horned Lizard (California protected); and Orange-Throated whiptail (California protected).

3.2.3 Federally Listed Threatened and Endangered Species at Camp Pendleton

Eighteen (18) federally threatened or endangered species are found on, or transit through, Camp Pendleton (Table 3-4). Although Camp Pendleton provides habitat for 18 of San Diego County's 38 federal threatened or endangered species, it encompasses less than 4.6% of total land area of San Diego County.

TABLE 3-4. Federally listed threatened and endangered plant and wildlife species at Camp Pendleton.

Common Name	Scientific Name
Birds	
Bald Eagle [a]	*Haliaeetus leucocephalus*
Brown Pelican [b]	*Pelecanus occidentalis*
California least tern	*Sterna antillarum browni*
Coastal California Gnatcatcher	*Polioptila californica californica*
Least Bell's Vireo	*Vireo bellii pusillus*
Light-footed Clapper Rail [c]	*Rallus longirostris levipes*
Peregrine Falcon [d]	*Falco peregrinus anatum*
Southwestern Willow Flycatcher	*Empidonax trailli extimus*
Western Snowy Plover	*Charadrius alexandrinus nivosus*
Mammals	
Pacific Pocket Mouse	*Perognathus longimembris pacificus*
Stephens' Kangaroo Rat	*Dipodomys stephensi*
Fish	
Southern Steelhead Trout [e]	*Oncorhynchus mykiss*
Tidewater Goby	*Eucyclogobius newberryi*
Amphibians	
Arroyo Toad	*Bufo californicus*
Crustacean	
Riverside Fairy Shrimp	*Streptocephalus woottoni*
San Diego Fairy Shrimp	*Branchinecta sandiegonensis*
Plants	
San Diego Button-Celery	*Eryngium aristulatum* var. *parishii*
Spreading Navarretia	*Navarretia fossalis*
Thread-Leaved Brodiaea	*Brodiaea filifolia*

[a] Known to occasionally transit the Base. The bald eagle has also been proposed for delisting in the lower 48 United States (USFWS 1999a).

[b] Known to frequently transit the Base.

[c] Only unpaired (possibly transient) light-footed clapper rails have been observed on Camp Pendleton since 1988 (Zembal & Hoffman 2000).

[d] The peregrine falcon was recently delisted (USFWS 1999b).

[e] The southern steelhead trout recently rediscovered upstream of the Base on the San Mateo Creek and is pending listing for the Camp Pendleton area.

Management of federal threatened and endangered species is conducted through the implementation of habitat based management plans for riparian, estuarine, coastal, and upland areas (Estuarine and Beach Ecosystem Conservation Plan [Appendix D], the Riparian Ecosystem Conservation Plan [Appendix E] and the Listed Upland Species Management Program [Appendix F]). These management plans are based on programmatic Biological Assessments and Biological Opinions, which contain the goals, objectives, and terms and conditions for managing federally listed species on Camp Pendleton.

Because federally listed threatened or endangered species present a special concern for wildlife management, Camp Pendleton regularly surveys and maps the location and distribution of these species and sensitive habitats (Figure 3-5; see also Appendix P for the tracking of USFWS Recovery Plan downlisting criteria and Camp Pendleton's contribution). Information from these surveys is updated periodically and disseminated to Camp Pendleton land and resource mangers and resource agencies. Not represented on Figure 3-5 are the bald eagle, the brown pelican, and the light-footed clapper rail. It is important to note that federally listed species are not surveyed within the Central Impact Area due to safety concerns.

3.2.3.1 BALD EAGLE

Status. – The USFWS listed the bald eagle (*Haliaeetus leucocephalus*), as endangered in the lower 48 states on 11 March 1967 (USFWS 1967). On 12 July 1995 the USFWS reclassified the bald eagle from endangered to threatened as a result of significant increase in numbers of nesting pairs, increased productivity and expanded distribution (USFWS 1995b). On 6 July 1999 the USFWS proposed to remove the bald eagle from the list of endangered and threatened species (USFWS 1999a). This proposal has not been finalized, nor has critical habitat been designated; however, a recovery plan for the bald eagle has been approved (USFWS 1986a).

Distribution and Occurrence. – The bald eagle ranges throughout much of North America, nesting on both coasts from Florida to Baja California, Mexico in the south and from Labrador to the western Aleutian Islands, Alaska in the north. The bald eagle inhabits estuaries, large lakes, reservoirs, major rivers, and some seacoast habitats. They usually nest in trees near water but are known to nest on cliffs.

In 1782, there were as many as 100,000 nesting bald eagles living in the continental U.S. (USFWS 2001a). Over the years due to pesticide contamination and hunting the bald eagle population dramatically decreased and by 1963 there were approximately 417 pairs. Due to recovery efforts, this number has risen and in 1998 the population increased to 5,748 nesting pairs (USFWS 2001a). Furthermore, the Pacific Region delisting goal of 800 nesting pairs has been achieved since 1995 and the numbers of pairs has continued to increase (USFWS 1999a). In California, the number of pairs has increased from 43 in 1992 to 143 in 1998 (USFWS 2001a).

The bald eagle is a rare raptor on Camp Pendleton. The nearest occupied breeding areas occur off Base, near Whelan Lake and within the Windmill Lake vicinity in Oceanside (Peter

Bloom, pers. comm. 2001). However the bald eagles use San Mateo and San Onofre drainages for foraging habitat during migration.

Threats. – The decline in population is attributed to loss of nesting habitat, due to development along the coast and near inland rivers and waterways, forest clearing and environmental contaminants (e.g., from dichlorodiphenyltrichloroethane [DDT] use in the 1940s, 1950s, and 1960s).

3.2.3.2 BROWN PELICAN

Status. – The USFWS listed the brown pelican (*Pelecanus occidentalis*) as federally endangered on 2 June 1970 (USFWS 1970a,b). No critical habitat has been designated for the brown pelican; however, a recovery plan has been approved (USFWS 1983).

Distribution and Occurrence. – Brown pelicans range from the Pacific, Atlantic, and Gulf coasts north to Nova Scotia. They nest on offshore islands from Maryland down to Venezuela, from California south to Chile. In the sixties and seventies, brown pelican populations decreased dramatically due to the consumption of fish that contained DDT and other hard pesticides. Populations recovered somewhat after DDT became unavailable, although, the range of this species has been slightly reduced. The southern California population is estimated at 4,500 to 5,000 breeding pairs. Although the brown pelican does not use the Base as a breeding ground, it feeds in shallow estuary waters and uses sand spits and offshore sandbars for daily loafing and as nocturnal roost areas.

Threats. – Brown pelicans and their habitat are threatened by erosion, plant succession, hurricanes, storms, tick infestations, eating contaminated fish caused by pesticides, sewage spills and oil spills, and unpredictable food supplies.

3.2.3.3 CALIFORNIA LEAST TERN

Status. – The California least tern (*Sterna antillarum browni*) was federally listed as an endangered species by the USFWS in 1970 (USFWS 1970a,b). No critical habitat has been designated for this species and the recovery plan has been revised several times (USFWS 1980, 1985a). An additional revision is expected by 2002.

Distribution and Occurrence. – The California least tern is a migratory bird that historically nested in large beach colonies along the coastline from southern Baja, Mexico to central coastal California. Over the years the California least tern nesting habitat has been drastically reduced as a result of regional urbanization. Nesting is currently limited to San Francisco Bay and areas along the coast from San Luis Obispo County to Sand Diego County. Largest concentrations of breeding pairs nest in Los Angeles, Orange, and San Diego Counties. Migration routes and wintering range for the California least tern are not well known; it is thought that this species winters along the Pacific Coast of Central America.

California least tern populations have declined since the early 1900s. At least 1,000 nesting

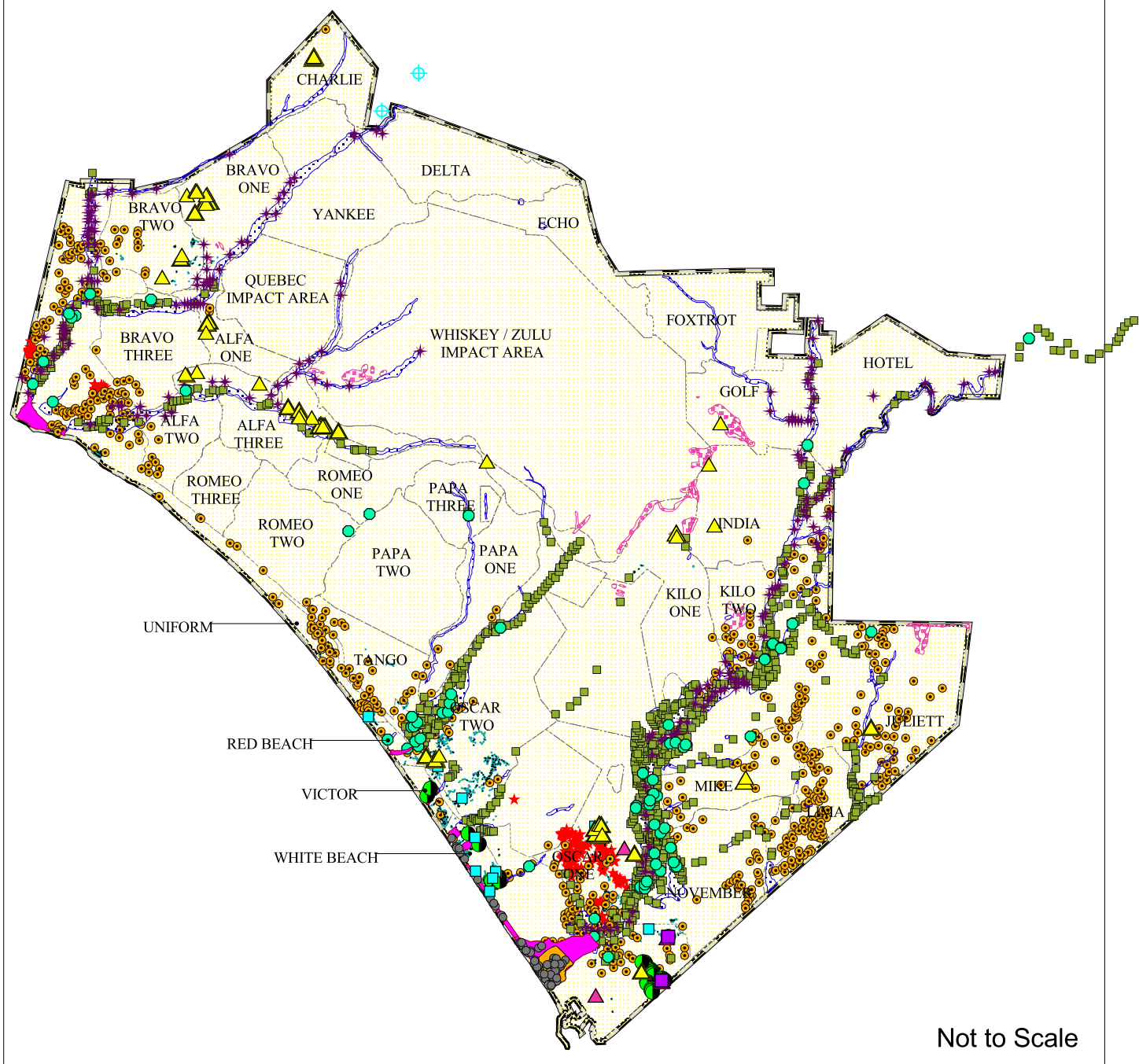

Figure 3-5
Threatened and Endangered Species

- **Camp Pendleton Boundary**
- Training Area Boundary
- Major Streams and Drainages
- Vernal Pool Groups
  - San Diego Fairy Shrimp
  - Riverside Fairy Shrimp
- California Least Tern
- Tidewater Goby
- Stephen's Kangaroo Rat
- San Diego Button Celery
- Spreading Navarretia
- San Diego Button Celery & Spreading Navarretia
- Thread-leaf Brodiaea
- Pacific Pocket Mouse
- Arroyo Toad
- Least Bell's Vireo
- Western Snowy Plover
- Southwestern Willow Flycatcher
- Coastal California Gnatcatcher
- Southern Steelhead Trout

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Map Source:
AC/S Environmental Security
GIS Branch
October 2001

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pairs of least terns were reportedly observed along a three-mile section of coastline in San Diego County from Pacific Beach to Mission Bay in the early 1900s (Foster 2001). By 1969, the statewide tern population was down to 182 pairs (Patton 2000). During the year of the listing, 1973, the statewide tern population totaled 600 pairs (Massey 1989; Caffrey 1993). Since then, intensive management practices have resulted in an increase in the tern population and by 1992 the statewide tern population was up to 2,106 nesting pairs (Massey 1989; Caffrey 1993).

Since 1969, the California least tern has spent the breeding phase of its life cycle on Camp Pendleton, typically arriving in mid-April and departing by September (Foster 2001). This small migratory tern nests colonially on undisturbed, sparsely vegetated, flat areas with loose, sandy, or salt pan substrate. On Camp Pendleton, California least tern nesting sites are located on the beaches at the mouths of the Santa Margarita River (Blue Beach), North Beach, French, and Aliso Creeks (White Beach). Nesting also occurs on the salt flats of the Santa Margarita Estuary. Figure 3-5 illustrates the general distribution of the California least tern on Base. Least terns are opportunistic feeders known to capture more than 50 species of fish in relatively shallow, nearshore waters and coastal freshwater ponds, channels, and lakes.

The Base follows active management practices for protecting the least tern breeding habitat. Beginning in 1988, the Base retained protective fencing around the Santa Margarita River nesting site throughout the year. Additionally, during the breeding season a fence is put up along all known breeding locations to protect the colonies from military training on the beach. Intensive predator control and monitoring programs are also practiced. As a result of these efforts, the Base has shown an increase in the nesting population. In 1992, 43% of the nesting population of California least terns was located on Department of Defense lands, including 18% on Camp Pendleton (Caffrey 1993). In 1999, the number of nesting pairs in San Diego County was up to 2,333, with 672 (29%) found on Camp Pendleton (Keane 1999). Additionally, results of the 2000 California statewide surveys show that 23% of the 4,522 nesting pairs are located on Camp Pendleton (Patton 2000).

Threats. – The decline in California least tern populations is largely attributable to loss of nesting and foraging habitat (e.g., from construction of Pacific Coast Highway, beach homes, etc.) and disturbance to breeding colonies, including dredging, filling, water pollution, development along shorelines, and domestic and wild animals (USFWS 1970, 1980).

3.2.3.4 COASTAL CALIFORNIA GNATCATCHER

Status. – The USFWS designated the coastal California gnatcatcher (*Polioptila californica californica*) as threatened on 30 March 1993 (USFWS 1993a). At the time the gnatcatcher was given federal protection as a threatened species, the U.S. Secretary of Interior issued a Special Rule designed to empower a habitat-oriented conservation planning law enacted by the State of California, the Natural Community Conservation Planning process (USFWS 1993a). The objectives of the NCCP program involve working with local governments and landowners to identify and protect habitat in sufficient amounts and distribution that will enable long term conservation of the coastal sage scrub community as well as other sensitive habitat types (CDFG 1992). The USFWS recently designated critical habitat for the coastal

California gnatcatcher in the southern California ecoregion, including on federal lands (USFWS 2000b). The USFWS concluded that the benefits of excluding Camp Pendleton exceed the benefits of including the Base in the critical habitat designation under Section 4(b)(2) to ensure that mission-critical military training activities can continue without interruption at Camp Pendleton. Currently, there is no recovery plan for the California gnatcatcher.

Distribution and Occurrence. – The coastal California gnatcatcher is a non-migratory bird with a range restricted to California and Baja California, Mexico. This subspecies is found from Ventura County south to San Diego County and east to San Bernardino County. On Camp Pendleton, the coastal California gnatcatcher's distribution is markedly clumped, with concentrations in the northern (State Park), coastal, and southern (inland) portions of the Base (Figure 3-5). The gnatcatcher occurs almost exclusively in the coastal sage community, but can also be found in chaparral and riparian habitats. The breeding season of the gnatcatcher extends from late February through July, with peak nesting activities occurring from mid-March through May.

Over the years intensive survey efforts on Base have resulted in an increase in known gnatcatcher populations. Surveys in 1989 found 179 gnatcatcher pairs on Camp Pendleton and in 1994 the population increased to 224 total sightings (note: total sightings includes pairs, individuals, and juveniles) (Griffith Wildlife Biology 1997a). A basewide survey (excluding the State Park lease areas) in 1994 found 554 coastal California gnatcatcher locations composed of 388 verified pairs, 47 single males, 14 single females, 30 birds of unknown sex (many were probably paired), and 75 juveniles not associated with family groups (Griffith Wildlife Biology 1997a). Foothill Transportation Corridor surveys conducted in 1995 and primarily in the State Park lease areas found 95 coastal California gnatcatchers. There was some overlap in the areas surveyed in 1994 and 1995. A 1998 basewide survey (including the State Park lease area) found 620 pairs of coastal California gnatcatcher (Atwood et al. 1999). Surveys were conducted in suitable scrub habitat within the defined study area of each effort. By placing a 500-ft-radius buffer around each 1998 coastal California gnatcatcher GIS point, and removing overlapping buffers and off-Base areas, approximately 8,260 acres are estimated to be occupied by coastal California gnatcatcher on Base. The distribution of coastal California gnatcatchers across the Base (excluding the State Park lease area) during 1994 and 1998 was similar. The 1998 population of gnatcatchers on Camp Pendleton accounts for 18% of the San Diego County population.

Threats. – Although numerous factors were involved in the decline of the coastal California gnatcatcher, habitat destruction and fragmentation are the principal reasons for the species' current threatened status. Agricultural use, urbanization, increased fire frequency, nest parasitism by cowbirds, and introduced exotics have adversely impacted extant sage scrub habitat.

3.2.3.5 LEAST BELL'S VIREO

Status. – The USFWS listed the least Bell's vireo (*Vireo bellii pusillus*) as an endangered species on 2 May 1986 (USFWS 1986b). Critical habitat for the least bell's vireo was

designated in 6 southern California counties on 2 February 1994 (USFWS 1994a). Camp Pendleton was excluded from this designation due to a MOU with the USFWS. A draft recovery plan is available for this species (USFWS 1998a).

Distribution and Occurrence. – Formerly common and widespread in California and northwestern Baja California, the least Bell's vireo was reduced to about 300 pairs in the mid-1980s. The vireo's dramatic decline is due to widespread loss of low elevation riparian habitat combined with range expansion by the brown-headed cowbird (*Molothrus ater*), a serious brood parasite of open-cup nesting songbirds. After active management measures (namely cowbird control and habitat conservation) were instituted in the early 1980s, the vireo population increased to an estimated 600 pairs in 1991 (Pavelka 1994).

The least Bell's vireo arrives at Camp Pendleton from mid-March to early April and leaves for its wintering ground in southern Baja California in August (Franzreb 1989). Vireos primarily inhabit dense willow-dominated riparian habitats with lush understory vegetation. They nest 3-4 feet above the ground in dense understory and use taller trees for foraging and singing perches (Salata 1981). Least Bell's vireos forage primarily in willows. However, vireos nesting on the edge of riparian habitat or in riparian corridors less than 150 feet wide have been observed foraging up to 180 feet away from the willow-riparian edge in coastal sage scrub and chaparral (Kus & Miner 1989). Home ranges of vireos in the Santa Margarita River habitat varied from less than ½acre to over 9 acres (mean 2.64 acres) in 1988; a majority were between 1 and 2 ½acres (Jones 1989). A summary of breeding and territorial male least Bell's vireos observed on Camp Pendleton between 1979 and 2000 is shown in Table 3-5. Figure 3-5 illustrates the general distribution of the least Bell's vireo on Base.

Active management for the least Bell's vireo on Camp Pendleton began in 1981. A cowbird live-trapping and removal program was first initiated in 1983 with 5 traps on the Santa Margarita River. The cowbird control program expanded to 33 traps basewide by 1994 and to 40 traps basewide in 2000. Since cowbird control began, the number of vireo locations at Camp Pendleton has increased from 62 to nearly 1000 (Griffith Wildlife Biology 2000). Additionally, the incidence of nest parasitism dropped from 47% in 1982 to 3.3% in 1986 (Beezley & Rieger 1986). As the trap design was improved and the number of traps increased, the incidence of cowbird nest parasitism continued to decline and reached 0.5% in 1990. Currently, the parasitism by cowbirds continues to diminish, but there are still high numbers of cowbirds being captured, indicating that little impact upon the regional cowbird population is being made over time. Populations of other species impacted by cowbirds, including the California gnatcatcher, Swainson's thrush (*Catharus ustulatus*), Hutton's vireo (*Vireo huttoni*), warbling vireo (*vireo gilvus*), Wilson's warbler (*Wilsonia pusilla*), yellow warbler (*Dendroica petechia*), yellow-breasted chat (*Icteria virens*), blue grosbeak (*Guiraca caerulea*), and lazuli bunting (*Passerina amoena*), have also increased on Camp Pendleton (Griffith Wildlife Biology 1994).

Under the Riparian BO (USFWS 1995a), Camp Pendleton maintains a minimum of 1,200 acres of riparian habitat to support the least Bell's vireo and other riparian species. Vegetation categories used by least Bell's vireo are riparian woodland, riparian scrub, and mixed woodland.

TABLE 3-5. Number of singing male least Bell's vireos [a] on different drainages at Camp Pendleton, 1978 to 2000 (data sources: Salata 1983; Pavelka 1994; Kus 1996; Griffith Wildlife Biology 1992, 1997b, 1998, 1999a, 2000). (Table modified from Griffith Wildlife Biology 1999b.)

		DRAINAGE [d]																
Year [b]	Field Hrs.[c]	SMR	CC	SMC	SOC	PDL	LFC	AC	FC	DLC	FBC	PBC	WC	PC	MIS	Total	% Growth [e]
1978		5		0			0									5	
1980	100	14		1	0		0			0				0		15	200
1981	300	26		0	0		1			0						27	80
1982	750	43		0	0		2			0						45	67
1983	615	60		0	0		1			1						62	38
1984	526	83		0	0		0			0						83	34
1985	511	86					0			1						87	5
1986	539	98		0	0		0			2						100	15
1987	760	142		3	0		4		0	3				4		156	56
1988	1375	200		1	0		3		0	2	0			4		210	34
1989	1184	154		0	0		5		0	2	0			11		172	-18 [f]
1990	964	189		1	0		8	0	0	0	0			11		209	22
1991	960	212		1	1		22	2	1	3	0			14		256	25
1993	307	319		4	3	1	59	5	1	3	6	1	1	20		423	65
1995	1243	426	2	23	15	1	125	12	7	24	11	1		44	5	696	65
1996	1120	523	5	48	27	1	148	24	10	26	16	2	2	48	22	902	30
1997	1260	540	4	51	30	1	164	19	9	24	2	3	1	61	26	935	3
1998	1546	567	3	55	40	9	157	22	6	15	15	6	5	68	43	1011	8
1999	1582	486	11	63	44	8	126	18	6	18	18	3	8	42	34	885	-12
2000	1602	440	9	56	40	3	112	23	7	22	14	3	7	35	36	807	-8

[a] Singing males include resident males (present > 30 days, paired, or single) and transient males (present <30 days). Transient males not included for total in 1981-1986, 1995.

[b] Comprehensive surveys were not performed in 1979, 1992, and 1994.

[c] Cursory walk by surveys in 1978 and 1980.

[d] Drainages: Santa Margarita River (**SMR**), Christianitos Creek (**CC**), San Mateo Creek (**SMC**), San Onofre Creek (**SOC**), Piedre de Lumbre (**PDL**), Las Flores Creek (**LFC**), Aliso Creek (**AC**), French Creek (**FC**), De Luz Creek (**DLC**), Fallbrook Creek (**FBC**), Pueblitos Canyon (**PBC**), Windmill Canyon (**WC**), Pilgrim Creek (**PC**), Miscellaneous (**MIS**). Blank cells represent no survey performed.

[e] Percent growth = (Current Year – Past Year/Past Year) x 100. Note 1980, 1993, and 1995 is over 2 years.

[f] The decrease in vireo numbers from 1988 –1989 and from 1998-1999 occurred throughout the subspecies range due to unknown causes.

Threats. – The decline in least Bell's vireos is attributed to permanent or long term loss and degradation of nesting habitat and riparian woodlands due to urban development, human disturbance, and nest parasitism by cowbirds (USFWS 1986b).

3.2.3.6 LIGHT-FOOTED CLAPPER RAIL

Status. – The light-footed clapper rail (*Rallus longirostris levipes*) was federally listed as an endangered species by the USFWS on 13 October 1970 (USFWS 1970b). No critical habitat has been designated for this species; however, a recovery plan is available (USFWS 1985b).

Distribution and Occurrence. – The light-footed clapper rail is a nonmigratory bird found in coastal fresh and salt water marshes in southern California and northern Baja, California, Mexico. Currently, the light-footed clapper rail is found in only a fraction of the marshes it once occupied. The rail has been absent from Los Angeles County since the early 1980s and populations in Santa Barbara County are also thinning. The largest number light-footed clapper rails, about 60% of the state breeding population, reside in Upper Newport Bay Ecological Reserve in Orange County (Zembal & Hoffman 2000).

The population and distribution of the clapper rail in California has varied over the years. In 1980, 203 pairs of light-footed clapper rails were observed in 11 different marshes; in 1996, 325 pairs were observed in 15 marshes; and, in 2000, 253 pairs were observed in 16 marshes (Zembal & Hoffman 2000). Some populations in California have been successfully augmented through the translocation of eggs (Zembal & Hoffman 2000).

On Camp Pendleton, Dr. Richard Zembel (formerly of the USFWS) has conducted independent surveys of the light-footed clapper rail annually from 1980 through 2000. The survey areas include San Mateo Creek Mouth, Las Flores Marsh, Cocklebur Canyon Mouth, and Santa Margarita Lagoon (note: not all locations were surveyed every year) (Zembal & Hoffman 2000). During these survey efforts, clapper rails were detected in the Santa Margarita River mouth (1982-1988), Cockleburr Canyon mouth (1982), and Las Flores Marsh (1983) (Zembal et al. 1984). Total sightings on Base were never greater than three pairs for a single survey season from 1982 to 1988. The reports from Cockleburr Canyon and Las Flores marsh are probably from transient birds (Zembal et al. 1984). In 1993 and 1997 unpaired rails were seen in the Santa Margarita Lagoon (Zembal & Hoffman 2000).

The light-footed clapper rail feeds mostly on clams, spiders, mussels, and crabs. Preferred marsh vegetation varies from salt marshes heavily dominated by pickleweed (*Salicornia virginica*) to freshwater marshes with dominant cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.) with occasional intermixed willows (*Salix* spp.) (Zembal & Massey 1986). In addition, scattered stands of spiny rush (*Juncus acutus* ssp. *leopoldii*) are critical for rail nest placement (Zembal & Hoffman 2000).

Threats. – The decline in light-footed clapper rails is attributed to urban development, human disturbance, predation, and a general loss or degradation of feeding and nesting habitat in coastal salt marshes and estuaries (USFWS 1970b).

3.2.3.7 PEREGRINE FALCON

Status. – The peregrine falcon (*Falco peregrinus anatum*) was listed as an endangered species on 2 June 1970 (USFWS 1970a,b). On 22 September 1977 critical habitat was designated for the peregrine falcon. Because of active management and recovery efforts, the peregrine falcon was delisted and designated critical habitat was removed on 25 August 1999 (USFWS 1999b). The peregrine falcon remains on the California list of threatened and endangered species as endangered and retains protection under the Migratory Bird Treaty Act.

Distribution and Occurrence. – In North America, peregrine falcons could be found in mountains and valleys as well as along the coastline from the Artic tundra down to Mexico. By the mid 1960's there were no peregrine falcons in the eastern United States. The decline spread westward and by the 1970s, western populations had declined by 90 percent. The peregrine falcon disappeared as a breeding species from southern California, and in many other parts of the western United States, southern Canada, and Northwest Territories. This drastic decline was caused by the consumption of DDT (USFWS 1999b). Beginning in 1974, various state provinces and national agencies in both Canada and the United States put forth great efforts for the recovery of the peregrine falcon. Since 1977, over 2700 peregrine falcons were released in the western United States (Tarski 2001). In 1998, the total known breeding population of peregrine falcons was 1,650 pairs in the United States and Canada (USFWS 1999b).

Peregrine falcons can be seen on Camp Pendleton at anytime of the year. In recent years, one of the five known historic nesting sites on Base has been occupied (P. Bloom, pers. comm. 2001). In addition, the peregrine falcon uses the mouth of the Santa Margarita River, San Mateo, and San Onofre Creeks to forage.

Threats. – The decline in the peregrine falcon population is attributed to environmental contaminants, primarily DDT and metal contaminants, and degradation of nesting and foraging habitats.

3.2.3.8 SOUTHWESTERN WILLOW FLYCATCHER

Status. – The southwestern willow flycatcher (*Empidonax traillii extimus*) was federally listed as an endangered species by the USFWS on 27 February 1995 (USFWS 1995c). On 22 July 1997 the USFWS designated critical habitat for this species (USFWS 1997a). A draft recovery plan has been published for comments (USFWS 2001b).

Distribution and Occurrence. – The southwestern willow flycatcher is a neotropical migrant. It arrives in breeding habitat as early as mid-May and may be present until mid-August. The breeding range of this flycatcher extends from southern California, east to western Texas, north to extreme southern Utah and Nevada, and south to extreme northern Baja California del Norte and Sonora (Unitt 1987). Migration routes and wintering range for the southwestern willow flycatcher are not well known; it is thought that this species winters in Mexico, Central America, and perhaps northern South America.

In the last 50 years the southwestern willow flycatcher has declined precipitously. Since 1992, more than 800 historic and new locations have been surveyed range wide to document the status of the species. In 1997, the estimated known population of the southwestern willow flycatcher was estimated between 300 and 500 pairs (USFWS 1997a).

TABLE 3-6. The distribution and abundance of singing (territorial) male southwestern willow flycatchers observed on different drainages at Camp Pendleton, 1981 to 1999 (data sources: Griffith Wildlife Biology 1997b, 1998, 1999a, 1999c; Kus 2001). [a]

		DRAINAGE [b]															
Year	Field Hrs.	SMR	NC	HC	CC	SMC	SOC	PDL	LFC	AC	FC	DLC	FBC	RC	WC	PC	Total
1981	na	5		ns			na					na				na	5
1982	na	10		ns			na					na				na	10
1983	na	10		ns			na					na				na	10
1984	na	16		ns			na					na				na	16
1985	na	15		ns			na					na				ns	15
1986	na	17		ns	ns	na	na	ns	na	ns	ns	ns	ns	ns	ns	2	19
1987	na	na		ns	ns	0	0	ns	0	ns	ns	na	ns	ns	ns	3	3
1988	1375	23		ns	ns	na	na	ns	na	ns	na	na	0	ns	ns	2	25
1989	1184	16		ns	0	0	0	0	0	0	0	0	0	0	0	2	18
1990	964	19		ns	0	0	0	0	1	0	0	0	0	0	0	3	23
1991	960	19		ns	0	0	0	0	1	0	1	3	0	0	0	2	26
1992	535	3		ns	0	0	0	1	0	0	0	3	0	0	0	0	7
1993	307	6		ns	0	0	0	0	1	0	0	0	0	0	0	2	9
1994	345	9		ns	0	0	7	0	3	0	0	0	0	0	0	4	23
1995	1120	10		1	0	2	1	0	3	0	0	1	1	0	0	6	25
1996		12		1	3	0	0		5							2	23
1997		16	3	1	ns	1	0		5							2	28
1998	1546	20	0	1		0	0		1				5			0	27
1999	1208	18														0	18
2000		18															18

[a] (**na**) survey performed but no data available, (**ns**) no survey performed.

[b] **Drainages**: Santa Margarita River (**SMR**), Newton Canyon (**NC**), Hidden Canyon (**HC**), Christianitos Creek (**CC**), San Mateo Creek (**SMC**), San Onofre Creek (**SOC**), Piedre de Lumbre (**PDL**), Las Flores Creek (**LFC**), Aliso Creek (**AC**), French Creek (**FC**), De Luz Creek (**DLC**), Fallbrook Creek (**FBC**), Roblar Creek (**RC**), Windmill Canyon (**WC**), Pilgrim Creek (**PC**).

The southwestern willow flycatcher's population on Camp Pendleton has varied considerably over the years. The number of singing males recorded on Camp Pendleton has ranged from 5 in 1981, increasing to 18, 23, and 26 (in 1989, 1990, and 1991, respectively), returning to a low of 7 in 1992 (Griffith Wildlife Biology 1998). Singing males have also ranged in choosing territories over the years. For example, on San Onofre Creek 7 males were found in 1994, one male was found in 1995, and no males have been found there since. The Santa Margarita River is the only drainage where males have consistently occurred over the years. Recently, in 1999 and 2000, the southwestern willow flycatcher was only found along the Santa Margarita River. A summary of distribution and abundance of singing (territorial) male southwestern willow flycatchers observed on Camp Pendleton between 1981 and 2000 is shown in Table 3-6. Figure 3-5 illustrates the general distribution of the southwestern willow flycatcher on Camp Pendleton.

The southwestern willow flycatcher inhabits riparian areas along rivers, streams, and other wetlands. It nests in typically even-aged, structurally homogeneous, dense stands of trees and shrubs approximately 13-23 feet tall with a high percentage of canopy cover and dense foliage from 0-13 feet above the ground (Brown 1988; Sedgewick & Knopf 1992). Nesting willow flycatchers in San Diego County prefer willow (*Salix* spp.), and mulefat (*Baccharis* spp.) thickets (Unitt 1987) and invariably nest near surface water or saturated soil (Phillips et al. 1964).

Threats. – The factors contributing to the decline of the southwestern willow flycatcher populations are attributed to human disturbance, nest parasitism by cowbirds, and permanent or long term loss and degradation of nesting habitat and riparian woodlands. Habitat loss and degradation are due to urban, recreational, and agricultural development; diminished water quality; fires; water projects; livestock grazing; and changes in the riparian plant community caused by exotic plant species.

On Camp Pendleton southwestern willow flycatchers have not responded as dramatically to cowbird control as have least Bell's vireos, suggesting that factors other than brood parasitism are preventing their recovery (Griffith Wildlife Biology 1999c). The decline of southwestern willow flycatcher population on Camp Pendleton is thought to be caused by the degradation of older, more complex willow riparian habitat, limited water flow during critical periods when adults are raising young, and the destructive effects of exceptionally high flows during winter and spring (leading to colonization of potentially high-quality habitat by invasive exotic species).

3.2.3.9 WESTERN SNOWY PLOVER

Status. – The western snowy plover (*Charadrius alexandrinus nivosus*) was listed by the USFWS as threatened on 5 March 1993 (USFWS 1993b). Critical habitat has been designated for this species, but not on Camp Pendleton due to the presence of an adequate management plan. A draft recovery plan for the western snowy plover is available (USFWS 2001c).

Distribution and Occurrence. – The western snowy plover breeds on the Pacific coast from

southern Washington to southern Baja California, Mexico, and in interior areas of Oregon, California, Nevada, Utah, New Mexico, Colorado, Kansas, Oklahoma, and north-central Texas, as well as coastal areas of Texas and possibly northeastern Mexico. The Pacific coast population of the western snowy plover is genetically isolated from western snowy plovers breeding in the interior (USFWS 1993b). The Pacific coast population of the western snowy plover is defined as those individuals that nest adjacent to or near tidal waters, and includes all nesting colonies on the mainland coast, peninsulas, offshore islands, adjacent bays, and estuaries (USFWS 1993b). The coastal population of the western snowy plover consists of both resident and migratory birds; some birds winter in the same areas used for breeding (USFWS 1993b). Migratory individuals of the coastal western snowy plover travel either north or south within their coastal range.

Since 1994, the Base has been performing yearly surveys for the western snowy plover (Pacific coast population) shown in Table 3-7. Nesting sites include: French Creek (White Beach), Cockleburr Beach, North Beach (South), South Beach, Blue Beach, and the Santa Margarita salt flats (Collier & Terp 2000). The Santa Margarita estuary on Camp Pendleton supports approximately 50 breeding pairs of western snowy plovers, nearly equivalent to the number of breeding pairs in the rest of San Diego County. In 1998, 42% of all the snowy plovers in San Diego County were breeding on Camp Pendleton (Collier & Terp 2000). Figure 3-5 illustrates the general distribution of the western snowy plover on Base.

TABLE 3-7. Western snowy plover nest monitoring data from 1994 to 2000.[a] (Data provided by USGS/USFWS nest monitors [Collier & Powell 2000]).

	1994	1995	1996	1997	1998	1999	2000 [b]
# Nests Found	46	111	112	106	82	50	48
Estimated # Males	40.25	78.90	66.54	55.45	49.02	42.00	37.62
Estimated # Females	35.78	55.65	53.54	42.12	43.94	34.13	39.11
Total Estimated # Individuals	76.03	134.54	120.08	97.57	92.96	76.13	76.73

[a] Number of breeding males and females based on actual number of known nests.

[b] Jill Terp (USFWS), pers. comm. 2001.

Plovers feed primarily on insects and other invertebrates that they find in the wet sand along the surf and in the lagoons. The plover lays its eggs in a shallow depression in the salt pan or salt flat area of an estuary or in beach dune areas near estuaries. It lays two to four eggs per nest, with two or three clutches in one year.

Threats. – The decline in the western snowy plover population is attributed to human disturbance, predation, and loss of nesting habitat to encroachment of introduced European beachgrass (*Ammophila arenaria*) and urban development (USFWS 1993b).

3.2.3.10 PACIFIC POCKET MOUSE

Status. – The USFWS emergency listed the Pacific pocket mouse (*Perognathus longimembris pacificus*) as endangered on 3 February 1994 (USFWS 1994b) and published the final listing on 29 September 1994 (USFWS 1994c). No critical habitat has been designated for this species; however, a recovery plan has been approved (USFWS 1998b).

Distribution and Occurrence. – Historically, Pacific pocket mice occurred within about 3 km of the immediate coast of southern California from Marina Del Rey and El Segundo in Los Angeles County south to the vicinity of the Mexican border in San Diego County. Within its range, the Pacific pocket mouse has a much localized distribution on suitable habitat. Currently, its only known localities include one population at Dana Point, California and three populations on Base (Figure 3-5): the Oscar One and Edson Range training areas, east of the San Onofre housing area (San Mateo South), and in the northeast corner of the Base between the Base boundary with San Clemente and Cristianitos Road (San Mateo North).

During a 10-day trapping period in 1996 (equivalent to 4,800 trap nights given the number of traps and survey effort), 112 Pacific pocket mice (unique individuals, not counting recaptures) in the Oscar One training area were captured (USFWS 1999c). In a separate survey effort that same season, the distribution of captures expanded the known range of the Pacific pocket mouse in the Oscar One training area from 6 to 385 hectares (USFWS 1999d). More recent presence/absence surveys documented Pacific pocket mice on the adjacent Edson Range training area (SJM Biological Consultants 1998). A survey in 1996 at the San Mateo South site produced 19 unique Pacific pocket mice after 5,975 trap nights (Ogden 1997). A 1996 survey tallied a minimum of 22 Pacific pocket mice at the San Mateo North site after a few thousand-trap nights (Brandman 1997). There is some discussion over San Mateo South and San Mateo North representing one or two separate populations; the sites are about one mile apart and are separated by an agriculture field, San Mateo Creek, and a paved, public access road. Camp Pendleton considers them as separate populations. By placing a 500-ft-radius buffer around all known Pacific pocket mouse GIS points, and removing overlapping buffers and off-Base areas, approximately 945 acres are estimated to be occupied by the Pacific pocket mouse on Base.

Threats. – Urban development and agriculture are threats to the survival of the Pacific pocket mouse. Urban development can destroy pocket mouse habitat and kill individuals. Construction projects can fragment habitat and isolate pocket mouse populations, thereby making them susceptible to catastrophic events such as fire. In addition, urban developments impact rodent populations indirectly by introducing and harboring domestic cats.

3.2.3.11 STEPHENS' KANGAROO RAT

Status. – The USFWS designated the Stephens' kangaroo rat (*Dipodomys stephensi*) as federally endangered on 30 September 1988 (USFWS 1988). Critical habitat has not been designated for this species, nor has a final recovery plan been approved. A draft recovery

plan is, however, available (USFWS 1997b).

Distribution and Occurrence. – The Stephens' kangaroo rat has a regional distribution extending along the San Jacinto Valley of San Diego, Riverside, and San Bernardino counties. Numerous small, fragmented populations scattered across a range of approximately 1,100 square miles characterize this distribution. A comprehensive, rangewide total of occupied habitat is not available. Surveys conducted on Camp Pendleton during 1994 to 1996 indicated approximately 800 acres of occupied Stephens' kangaroo rat habitat (Montgomery et al. 1996, 1997). However, subsequent field studies indicated that the area of occupied Stephens' kangaroo rat habitat on the Base has decreased to approximately 684 acres (15% reduction), due to the apparent extirpation of this species at Range 313A, the 210 Series Ranges, and Range 116 (Tetra Tech, Inc. 1999). The Stephens' kangaroo rat requires sparse coastal sage scrub and grassland. Moderate human disturbances (e.g., certain grazing regimes, brush removal, mowing, and fires) can benefit Stephens' kangaroo rat habitat by maintaining sparse shrub growth. When these factors are removed, the habitat on site may change to more dense coastal sage scrub or introduced European grassland conditions that are not favorable to the Stephens' kangaroo rat. The USFWS states that the Stephens' kangaroo rat is frequently found in close association with dirt roads, previously and currently disturbed areas, and/or other sites with a high percentage of bare ground (USFWS 1997b). Figure 3-5 illustrates the general distribution of the Stephens' kangaroo rat on Camp Pendleton.

Threats. – Agriculture and urban development have greatly reduced and fragmented the amount of habitat available for Stephens' kangaroo rat. As a result, the Stephens' kangaroo rat is more susceptible to the effects of grazing, off-road vehicle activity, rodenticide use, decreased genetic diversity, and domestic cat predation.

3.2.3.12 SOUTHERN STEELHEAD TROUT

Status. – The southern California evolutionarily significant unit of the southern steelhead trout (*Oncorhynchus mykiss*) was federally listed as an endangered species by the National Marine Fisheries Service (NMFS) on 18 August 1997 (NMFS 1997) and by the USFWS on 17 June 1998 (USFWS 1998c). The southern limit of this federal listing extended to Malibu Creek in Los Angeles County, north of Camp Pendleton. Critical habitat was designated for this evolutionarily significant unit of steelhead on 16 February 2000 (NMFS 2000a). On 19 December 2000 (NMFS 2000b) the NMFS issued a proposed rule to extend the current range of the southern California steelhead to include the population of steelhead recently found in San Mateo Creek located in northern San Diego County. To assist in the determination of a ruling, the California Department of Fish and Game prepared a report for NMFS (CDFG 2000b) on the steelhead in San Mateo Creek and the public comment period had been extended. At the time of publication of this document, the proposed rule for range extension had not been finalized. A steelhead restoration and management plan for California is available by the Department of Fish and Game (McEwan & Jackson 1996).

Distribution and Occurrence. – Historically, the steelhead ranged throughout the eastern Pacific Ocean from the Kuskokwim River in Alaska to the Rio del Presidio in Baja

California. Southern steelhead (those occurring south of San Francisco Bay) were formerly found in coastal drainages as far south as the Santo Domingo River in northern Baja California and were present in streams and rivers of Los Angeles, Orange, and San Diego counties (McEwan & Jackson 1996). In 1946, Hubbs reported steelhead making runs in San Mateo, San Onofre, and San Juan creeks and in the San Diego, San Luis Rey, and Tijuana rivers of Orange and San Diego counties (McEwan & Jackson 1996). Steelhead had thought to be extirpated from much of its historic range in southern California; the San Mateo Creek population had previously been classified by some researchers as extinct (Nehlsen et al. 1991). In 1999, the first reoccurrence of a juvenile steelhead was observed in San Mateo creek (CDFG 2000b). Between 3 March and 3 September 1999, 78 steelhead/rainbow trout observations were made (CDFG 2000b). In 2000, the numbers of steelhead observed declined from 3 adults and 17 juveniles observed in June to only one juvenile seen in November (Hovey 2000a-f). Figure 3-5 illustrates the general locations of steelhead observances in the San Mateo Creek.

Threats. – The major factor affecting the southern steelhead populations are from urbanization and other watershed disturbances, blocked access to headwater spawning and rearing areas, and partial and total dewatering of streams by water diversions and groundwater pumping (McEwan & Jackson 1996). Additionally, increased soil erosion, loss of riparian vegetation, water pollution, and introduced predators and competitors are affecting the steelhead population.

3.2.3.13 TIDEWATER GOBY

Status. – The tidewater goby (*Eucyclogobius newberryi*) was federally listed as an endangered species by the USFWS on 4 February 1994 (USFWS 1994d). On 24 June 1999, the USFWS proposed to delist the northern populations of the tidewater goby and to retain the endangered status in Orange and San Diego Counties. This proposal is based on the conclusion that the southern California populations are genetically distinct and represent a distinct population segment (USFWS 1999e). On 20 November 2000, the USFWS designated 10 coastal stream segments, totaling approximately 9 linear miles of rivers, streams, and estuaries in Orange and San Diego Counties as critical habitat for the tidewater goby (USFWS 2000a). A draft recovery plan for the tidewater goby is available (USFWS 1996).

Distribution and Occurrence. – Tidewater gobies are a California endemic species and are unique in that they are restricted to coastal brackish water habitats (USFWS 2000a). At the time of listing, it was believed that this species historically occurred in at least 87 of California's coastal lagoons, ranging from Agua Hedionda Lagoon (northern San Diego County) to Tillas Slough (mouth of the Smith River), Del Norte County, California. Only 46 goby populations were believed extant at the time of listing, representing an approximate 50 percent decline of known populations (USFWS 1999e). In 1999, an estimated 85 tidewater goby populations were believed to be extant and the number of historical populations was estimated to be about 110 (USFWS 1999e). Of the 13 historic sites in Orange and San Diego counties, only 8 populations of gobies remain, with all locations occurring on Camp Pendleton (USFWS 2000a).

Overall, gobies are not present in all habitats during every month, and their distribution and density may vary seasonally and spatially. On Camp Pendleton, the extirpation and recolonization of gobies fluctuate yearly between lagoons. Tidewater gobies were recorded in San Onofre lagoon from 1974 to 1991, but could not be found in 1993 or 1994. In contrast, 1996 surveys of San Onofre found the goby population rise to 12,265. Surveys conducted in San Mateo drainage during 1992 found no gobies, in 1994, the estimated population was 292 and in 1996 there was a substantial increase in population estimated at 73,500.

Tidewater goby occurrences on Camp Pendleton, from 1987 through 2001, are shown in Table 3-8. Prior to the flooding of 1993, there were four known populations of tidewater gobies remaining south of the Santa Clara River, Ventura County, all of which are located on Camp Pendleton. The gobies had been found in the lagoons at San Onofre Creek, Las Flores Creek, Santa Margarita River, and Cockleburr Creek. No gobies were found in the San Mateo lagoon. After the flooding in 1993, a survey was conducted and found gobies present in San Mateo lagoon, but absent from the Santa Margarita River and San Onofre lagoon. Furthermore, high flow events do not necessarily result in local extirpation of goby populations. Recent observations, suggest that flood events function as dispersal mechanism by washing gobies out to the littoral zone of the ocean where they are carried by longshore currents to other estuaries down coast (Lafferty et al. 1999). These populations comprised approximately 6.4 to 7 percent of the total remaining population of the species (Holland 1992). Figure 3-5 illustrates the general distribution of the tidewater goby on Camp Pendleton.

The tidewater goby occurs in the coastal, brackish-water habitats in the lower reaches of coastal rivers, streams, lagoons, and occasionally small lakes or ponds. They typically occur in shallow (< 1.0 meter) quiet to slow moving water (Irwin & Stoltz 1984) and avoid fast moving waters. Gobies for the most part are associated with mud, sand, gravel, and cobble bottom substrates. Tidewater gobies have been found in salinities ranging from 0 to 28 parts per thousand (ppt) (Irwin & Stoltz 1984) and are most commonly found in salinities <10 ppt (Swift 1989). The species tolerance of high salinities (up to 60 ppt for varying time periods) likely enables it to withstand exposure to the marine environment, allowing it to colonize or reestablish in lagoons and estuaries (USFWS 2000a). Tidewater gobies feed primarily on small benthic invertebrates, crustaceans, including aquatic insect larvae, snails, and shrimp.

Threats. – The major factors affecting the tidewater goby are direct loss of wetland habitat to coastal development, drought, and flooding. In addition to directly affecting the goby, these factors are also responsible for indirect loss of habitat due to associated changes in salinity, temperature, and nutrient profiles; increased siltation; associated changes in substrate; and changes in current flows. This may affect the size, distribution, and breeding and foraging activities of the goby (Holland 1992). Other potential threats to tidewater gobies are nonnative predators or competitors, including sunfish (*Centrarchidae*), largemouth bass (*Micropterus salmoides*), striped bass (*Morone saxatilis*), channel catfish (*Ictalurus punctatus*), mosquitofish, and yellowfin gobies (*Acanthogobius flavimanus*).

TABLE 3-8. Tidewater goby survey data for different drainages at Camp Pendleton (data sources: Holland et al. 2001; Michael Brandman Associates 1998; Swift & Holland 1998; Swift et al. 1994; Swift 1999a, 1999b). [a]

	Drainage							
Year	San Mateo	San Onofre	Las Flores	Hidden	Aliso	French	Cockleburr	Santa Margarita
1987	-	+	+	U	U	U	-	U
1988	-	+	+	U	U	U	-	+
1989	-	+	+	U	U	U	-	+
1990	-	+	+	U	-	-	-	+
1991	-	+	+	U	-	-	-	+
1992	U	-	+	U	UA	UA	+	U
1993	+	-	+	+	-	-	+	-
1994	UP	U	UP	UP	U	U	UP	UA
1995	+	U	UP	UP	U	U	UP	UA
1996	+	+	+	+	+	+	+	-
1997	+	+	+	+	+	+	+	-
1998	+/- [b]	+	+	+	+	+	+	-
1999	-	+	UP	UP	UP	UP	UP	-
2000	+	+	+	+	+	+/- [c]	+	+
2001	+	+	+	+	+	-	+	+

[a] Survey data codes: (**+**) present; (**-**) absent; (**U**) Unknown (no sampling or survey data); (**UA**) Unknown but likely absent; (**UP**) Unknown but likely present.

[b] Extirpated by North County Transit District in early 1998.

[c] Present in June 2000, extirpated by October 2000.

3.2.3.14 ARROYO TOAD

Status. – The arroyo toad (*Bufo californicus*) was listed as a federally endangered species on 16 December 1994 (USFWS 1994e). The USFWS designated critical habitat for the arroyo toad on 7 February 2001 (USFWS 2001d,e). Portions of Camp Pendleton outside of the leased lands on San Mateo Creek were excluded from designated under Section 4(b)(2) to ensure that mission critical military training activities can continue while the INRMP and programmatic uplands consultation are being completed (USFWS 2001d,e). A recovery plan has been approved for this species (USFWS 1999f).

Distribution and Occurrence. – On Camp Pendleton, the arroyo toad occurs only in three drainages (Figure 3-5): Santa Margarita, San Onofre, and San Mateo. The population in the Santa Margarita drainage represents the only one occurring on an undammed major river system within southern California (Holland & Goodman 1998a). Endemic to southern California, arroyo toads were found historically along the length of drainages from southern California south into northwestern Baja California, but now they survive only in the headwaters as small isolated populations (Sweet 1993). The recovery plan (USFWS 1999f) identifies 22 drainage basins with recorded arroyo toad sightings since the early part of the

twentieth century. Two of the drainages had only single, unverified records at each, and arroyo toads are believed to be extirpated from a third drainage. Therefore, Camp Pendleton contains 3 of the remaining 19 drainage basins where arroyo toads are reasonably believed to be extant. It is likely that some of the largest remaining populations of this species occur on Camp Pendleton (Holland & Goodman 1998a). The lower portions of the San Mateo Creek basin, the San Onofre Creek, and Santa Margarita River, all of which are located on Camp Pendleton, may be the only remaining coastal plain lands in southern California on which the arroyo toad occurs within 10 kilometers (6 miles) of the coastline and down to the coastal marsh zone (USFWS 1999f). Arroyo toad use of upland habitat region wide is poorly understood.

Threats. – Habitat destruction and population isolation has put arroyo toads at a risk of extinction. Threats to arroyo toad survival include stream channel modification, exotic plants, fire, and exotic predators. Channeling streams increases flow rates, which reduces the availability of breeding habitat. Exotic plants such as water cress (*Rorippa* spp.) and giant reed (*Arundo donax*) directly and indirectly affect the condition and formation of ideal breeding pools. Fire may directly kill toads by burning their refugia and indirectly affect breeding habitat by increasing the rate of water flow. Disturbances such as fire, agriculture, and road construction can increase sedimentation in arroyo toad breeding pools, rendering them unusable. Older larvae fall prey to exotic fish and crayfish (Jennings & Hayes 1994). Bullfrogs are voracious predators that eat adult toads and are suspected of eating larvae and metamorphs. Arroyo toads are also killed by vehicular traffic and road maintenance.

3.2.3.15 RIVERSIDE FAIRY SHRIMP

Status. – The USFWS listed the Riverside fairy shrimp (*Streptocephalus woottoni*) as federally endangered on 3 August 1993 (USFWS 1993c). Critical habitat for this species has been proposed (USFWS 2000c). A recovery plan has been approved for the listed species of southern California vernal pools (USFWS 1998d).

Distribution and Occurrence. – The range of the Riverside fairy shrimp is from Orange County and southwestern Riverside County south to Otay Mesa on the Mexican border and continuing down into Baja California. The coastal mesas on Camp Pendleton support one of the largest known populations of this species, with at least 81 pools occupied by shrimp (73 with Riverside fairy shrimp and 8 with both Riverside fairy shrimp and San Diego fairy shrimp) (RECON 1998a). These 81 pools represent about 60% (81 of 135) of all known Riverside fairy shrimp occupied pools (Moeur 1998).

Initial reconnaissance surveys for Riverside fairy shrimp were conducted in 1993 and began at the bluffs and small mesa southwest of the I-5 southbound rest stop (White Beach) and radiated outward from there. Much of the area contained mima mound topography. The greatest number of Riverside fairy shrimp occupied pools was found near the White Beach rest stop on both sides of I-5 (Figure 3-5). Basewide survey efforts were conducted by RECON in the 1997/98 wet season. The draft report (RECON 1998a) of the results from those surveys indicate that Riverside fairy shrimp, eight of which are also occupied by San Diego fairy shrimp, occupies 81 pools.

Threats. – The Riverside fairy shrimp is threatened by habitat loss and degradation due to urban and agricultural development, off-road vehicle use, trampling, and other factors. Further fragmentation and destruction of isolated vernal pool groups can also have subtle but significant adverse effects. Zedler (1987) found that species diversity within vernal pools and genetic diversity within a single species are evenly distributed throughout a given group of pools and between groups of pools. Thus, preservation of fewer pools may reduce the overall genetic variability of the species, conceivably affecting its long term viability. Theoretically, even those areas specifically set aside to protect vernal pools may exhibit significant deterioration of viability if compromised by continued isolation and fragmentation of remaining pools (Bauder 1986).

3.2.3.16 SAN DIEGO FAIRY SHRIMP

Status. – The San Diego fairy shrimp (*Branchinecta sandiegonensis*) was listed as federally endangered on 3 February 1997 (USFWS 1997c). The USFWS has recently designated, critical habitat for this species. The San Diego fairy shrimp is included in the approved recovery plan for the listed species of southern California vernal pools (USFWS 1998d).

Distribution and Occurrence. – San Diego fairy shrimp are restricted to vernal pools in coastal southern California south to extreme northwestern Baja California, with San Diego County supporting the largest number of remaining occupied vernal pools (USFWS 2000d). The USFWS (2000d) estimated at the time of listing that fewer than 202 acres of occupied vernal pool habitat remained in San Diego County, of which an estimated 70 percent was estimated to occur on military lands.

On Camp Pendleton, the San Diego fairy shrimp shares the same coastal strip distribution as the Riverside fairy shrimp. However, within this limited range, especially in the southwestern part of the Base, the San Diego fairy shrimp occurs more often than either Lindahl's fairy shrimp (*Branchinecta lindahli)* or Riverside fairy shrimp. On the Base, San Diego fairy shrimp appears to be locally abundant in natural vernal pools and in man-made pools that have not been disturbed in several seasons (Moeur 1998). Generally speaking, vernal pools of high natural quality will be occupied by San Diego fairy shrimp while more degraded pools have a greater likelihood of containing Lindahls fairy shrimp. San Diego fairy shrimp occur primarily in Victor, Oscar One, and Oscar Two training areas and in the Wire Mountain housing area (Figure 3-5). Basewide survey efforts were conducted by RECON in the 1997/98 wet season. The draft report (RECON 1998a) of the results from those surveys indicates that 216 pools are occupied by San Diego fairy shrimp, eight of which are also occupied by Riverside fairy shrimp.

Threats. – Regionally, the San Diego fairy shrimp is threatened by habitat destruction from urban and water development, flood control, highway and utility projects, as well as conversion of wildlands to agricultural use. Changes in hydrologic pattern, overgrazing, and off-road vehicle activity also imperil this species.

3.2.3.17 SAN DIEGO BUTTON-CELERY

Status. – San Diego button-celery (*Eryngium aristulatum* var. *parishii)* was proposed for listing as endangered on 3 August 1993 (USFWS 1993c). Critical habitat has not been proposed for this species. San Diego button-celery is included in the approved recovery plan for the listed species of southern California vernal pools (USFWS 1998d).

Distribution and Occurrence. – San Diego button-celery ranges from Riverside County, California, south to northern Baja California, Mexico (Constance 1977). In 1979, San Diego button-celery was known from 65 pool groups; by 1986, this species remained in 61 pool groups (USFWS 1993c). Currently, it occurs in the Santa Rosa Plateau in Riverside County; in northern San Diego County on Camp Pendleton; and in San Marcos, Carlsbad, and Ramona. It also occurs on the northern mesas within the City of San Diego and on Otay Mesa in southern San Diego County.

On Camp Pendleton, San Diego button-celery has been found in a total of 67 vernal pools basewide, with 14 occupied pools occurring along the coast (Victor, Red Beach, and White Beach areas), 52 occupied pools inland near the Wire Mountain housing development, and 1 occupied pool within the Oscar One training area (Figure 3-5). The known locations of San Diego button-celery on Base are a compilation of multiple survey efforts (some basewide, others site specific) over many years. The earliest known survey that identified this species on Base was conducted by Pacific Southwest Biological Services, Inc. (1986). Years later, Dudek & Associates, Inc. (1996) conducted a basewide rare plant survey and was the first to map San Diego button-celery locations on Base using GPS technology. During their basewide surveys in 1997, RECON (1998b) identified an additional 44 pools containing San Diego button-celery (included in the total above).

Threats. – San Diego button-celery, as with other vernal pool species, is threatened by the loss of habitat. In general, vernal pool habitat in San Diego County has declined 97 percent (from 23,859 ha to 838 ha) since the early 1900s (Oberbauer 1990). Most of the remaining vernal pools, particularly in San Diego County, face threats from increasing urban development. The USFWS has identified several other threats, including agricultural development, off-road vehicular activity, trampling by people and livestock, roadway development, military activities, and watershed (drainage) alteration.

3.2.3.18 SPREADING NAVARRETIA

Status. – Spreading navarretia (*Navarretia fossalis*) was listed as threatened on 13 October 1998 (USFWS 1998e). Critical habitat for this species has not been proposed. Spreading navarretia is included in the approved recovery plan for the listed species of southern California vernal pools (USFWS 1998d).

Distribution and Occurrence. – Currently, Spreading navarretia is known from widely disjunct and highly restricted populations extending from the Santa Clarita region of Los Angeles County, east to the western lowlands of Riverside County, south through coastal and foothill San Diego County, and as far south as San Quentin in northern Baja California,

Mexico. Fewer than 30 populations exist in the United States. Nearly 60 percent of these populations are concentrated in three locations in southern California: Otay Mesa in southern San Diego County, the San Jacinto River in western Riverside County, and Hemet in Riverside County.

On Camp Pendleton spreading navarretia has been found in 9 vernal pools basewide, 7 pools in the Wire Mountain housing development area and 2 pools within the Oscar One training area (Figure 3-5). The known locations of spreading navarretia on Base are a compilation of multiple survey efforts (some basewide, others site specific) over many years. During surveys of the Base in the late 1980s, Pacific Southwest Biological Services, Inc. (1986, 1987, 1988, & 1990) identified only one population of spreading navarretia on the mesa east of Newton Canyon. In 1993, the species was found in at least three additional nearby sites (Dudek 1993). Spreading navarretia was also discovered in a large vernal pool at the edge of a lawn near Camp Del Mar, west of Interstate 5, near the southern end of the Base. During their basewide surveys in 1997, RECON (1998b) identified nine vernal pools with spreading navarretia.

Threats. – Spreading navarretia, as with other vernal pool species, is threatened by the loss of vernal pool habitat. In general, vernal pool habitat in San Diego County has declined 97 percent (from 23,859 ha to 838 ha) since the early 1900s (Oberbauer 1990). Most of the remaining vernal pools, particularly in San Diego County, face threats from increasing urban development. The USFWS has identified several other threats, including agricultural development, pipeline construction, drained or channelized wetlands, off-road vehicle activity, cattle and sheep grazing, weed abatement, fire suppression activities, and competition from nonnative plant species.

3.2.3.19 THREAD-LEAVED BRODIAEA

Status. – Thread-leaved brodiaea (*Brodiaea filifolia)* was listed by the USFWS as a threatened species on 13 October 1998 (USFWS 1998e). The USFWS found that designation of "critical habitat" for this species was not prudent at that time because such designation would provide no benefit over that provided by listing on privately owned lands (USFWS 1998e). Critical habitat for this species has not been proposed. No recovery plan has been approved.

Distribution and Occurrence. – The historical range of thread-leaved brodiaea extends from the foothills of the San Gabriel Mountains at Glendora (Los Angeles County), east to Arrowhead Hot Springs in the western foothills of the San Bernardino Mountains (San Bernardino County), and south through eastern Orange and western Riverside Counties to Carlsbad in northwestern San Diego County, California. A small isolated population of thread-leaved brodiaea is situated just west of Rancho Bernardo in central San Diego County (Morey 1995; CDFG 1997; Roberts & Vanderwier 1997).

Sixty populations of thread-leaved brodiaea have been reported, including the populations at Camp Pendleton. At least 9 of these populations have been extirpated, primarily in San Diego County. Fifty-one populations are presumed extant. Less than half of these remaining

populations are clustered in the expanding cities of Vista, San Marcos, and Carlsbad (9 populations) and in the vicinity of the Santa Rosa Plateau (6 populations). The remaining 35 populations are scattered within Orange, Los Angeles, Riverside, San Bernardino, and San Diego counties.

Thread-leaved brodiaea occupies an estimated 825 acres of suitable habitat. Of this habitat, 40% is reported from a single area, Miller Peak just north of the Base. The majority of the populations are within 2- to 10-acre patches. Because individuals require several years to mature and frequently only a fraction of mature individuals flower in a given year, the total number of individuals within a population is difficult to estimate. Moreover, the size and extent of populations of thread-leaved brodiaea within suitable habitat also vary in response to the timing and amount of rainfall, as well as temperature patterns. Fewer than 500 individuals have been observed within half of the populations. Populations exceeding 5,000 flowering stalks have been reported in only six localities (CDFG 1997; Roberts & Vanderwier 1997). Several populations have also significantly hybridized with other brodiaea species, such as Orcutt's brodiaea (*Brodiaea orcuttii*) and Mesa brodiaea (*B. jolonensis*), where these species co-occur (Morey 1995).

On Camp Pendleton, thread-leaved brodiaea has been found at 22 general localities, within which may be multiple sites. Thread-leaved brodiaea was first located on Base in 1993 during surveys in what are now Bravo One and Bravo Two training areas (Dudek & Associates 1993). During those surveys, several large populations (up to 2,000 individuals each) were discovered.

In 1997, most of the known thread-leaved brodiaea sites were visited during another basewide rare plant survey (RECON 1998c). This survey examined most of the potential thread-leaved brodiaea habitat, and an additional 14 sites were discovered. These new locations were all identified on clay pan soils within the Las Flores Mesa area of Oscar Two training area and in the Talega Canyon area of Charlie training area. It should be noted that many of the 1997 surveys were conducted early in the blooming season in order to detect the presence of early season clay endemics, such as Blochman's Dudleya *(Dudleya blochmaniae)* and Palmer's grapplinghook *(Harpagonella palmeri)*. Thread-leaved brodiaea, however, is a late season clay endemic; therefore, early season survey efforts may have failed to detect some locations for this species (RECON 1998c). As mentioned above, seven new sites were recorded in the Spring 2000, brining the total number of sites to 22. These new sites are located in the following training and cantonment areas: Bravo One, Bravo Two, 52 Area, Alfa One, India and Golf. Figure 3-5 illustrates the general distribution of thread-leaved brodiaea on Base.

Threats. – The USFWS has identified several threats to this species across its range, including habitat destruction, degradation, and fragmentation resulting from agriculture, urbanization, pipeline construction, alteration of wetland hydrology, clay mining, off-road vehicle activity, weed abatement, and invasive nonnative plant species.

Over the past 15 years, nearly 60 ha (148 ac) of occupied habitat containing over 80,000 plants have been eliminated in the cities of San Marcos and Vista. Remaining populations of thread-leaved brodiaea occupy less that 243 ha (600 ac) of habitat. The total number of

individuals of this species and the extent of occupied habitat vary on an annual basis in direct response to both the timing and amount of rainfall as well as temperature patterns. Most extant locations of this species contain fewer than 2,000 plants and often occupy less than 16 ha (40 ac) of habitat.

3.2.4 Landscape Linkages and Wildlife Corridors

Landscape (or habitat) linkages are open space natural areas that provide connectivity among and between habitat patches, and provide locations for native plants and seasonal or year-round habitat for wildlife. Linkages may also provide wildlife corridors (see below) for the movement of individuals or populations between habitat areas.

The identification, conservation, and protection of landscape linkages and wildlife corridors are essential to the long term sustainability of many species in the southern California region. The increasing fragmentation of open space areas by urbanization has created small, isolated "islands" of habitat. Both empirical studies and evolutionary theory have shown that small, genetically isolated populations are particularly vulnerable to extinction. In the absence of habitat linkages and wildlife corridors that allow movement to adjoining open space areas, various studies have concluded that some species, especially the larger and more mobile mammals, will not likely persist over time (MacArthur & Wilson 1967; Soule 1987; Harris & Gallagher 1989; Bennett 1990). Corridors connecting the larger patches of natural habitat areas and open spaces mitigate the effects of this fragmentation, to some degree, by: (1) allowing gene flow (interbreeding and genetic exchange) between otherwise small and genetically isolated populations; (2) providing escape routes from fire, predators, human disturbances, and other potentially catastrophic events that could result in local extinction; and (3) serving as travel routes for individual animals as they move within their home ranges in search of food, water, mates, and other needs (Noss 1983; Farhig & Merriam 1985; Simberloff & Cox 1987; Harris & Gallagher 1989).

The largely undeveloped, contiguous stretches of habitat on Camp Pendleton function as one of the last remaining landscape linkages, and the only remaining coastal linkage, between the few remaining open spaces in Los Angeles and Orange Counties to the north, Riverside County to the northeast, and northern San Diego County to the south. While Camp Pendleton may be large enough to maintain self-sustaining populations of some species for a reasonably long period of time, the long term sustainability of most species (both within the region and on Base) will likely be threatened should habitat linkages and wildlife corridors between the Base and surrounding areas be effectively removed.

3.2.4.1 WILDLIFE CORRIDOR DEFINITIONS

Wildlife corridors are narrow connections among and between habitat patches that are intended to allow for wildlife movement and dispersal. Wildlife corridors can be viewed as being local (e.g., within Camp Pendleton) or regional. Local corridors are important because they allow resident wildlife access to resources and they function as connections to habitat patches in the surrounding region. Wildlife corridors often follow major drainages and open

ridgelines. In general, wildlife corridors link together areas of suitable wildlife habitat that are otherwise separated by rugged terrain, changes in vegetation, or human disturbance.

Wildlife movement activities usually fall into one of three categories: (1) dispersal (e.g., juvenile animals from natal areas, individuals extending range distributions); (2) seasonal migration; and (3) movements related to home range activities (foraging for food or water, defending territories, searching for mates, breeding areas, or cover). A number of terms have been used in various wildlife movement studies, such as "travel routes," "wildlife corridors," "habitat linkages," and "wildlife crossings," to refer to areas in which wildlife move from one area to another. To clarify the meaning of these terms and facilitate discussions on wildlife movement, these terms are defined as follows:

- Travel routes: A landscape (such as a ridgeline, drainage, canyon or riparian strip) within a larger natural habitat area that is used frequently by animals to facilitate movement and provide access to necessary resources (e.g., water, food cover, den sites). The travel route is generally preferred because it provides the least amount of topographic resistance in moving from one area to another; it contains adequate food, water, and/or cover while moving between habitat areas; and provides a relatively direct link between target habitat areas.

- Wildlife corridor: A piece of habitat, usually linear in nature, that connects two or more habitat patches that would otherwise be fragmented or isolated from one another. Urban land areas or other areas unsuitable for wildlife usually border wildlife corridors. The corridor generally contains suitable cover, food and/or water to support species and facilitate movement while in the corridor. Larger, landscape-level corridors (often referred to generally as "habitat or landscape linkages") can provide both transitory and resident habitat for a variety of species.

- Wildlife crossing: A small, narrow area relatively short in length and generally constricted in nature, that allows wildlife to pass under or through an obstacle or barrier that otherwise hinders or prevents movement. Crossings typically are manmade and include culverts, underpasses, drainage pipes, and tunnels to provide access across or under roads, highways, pipelines, or other physical obstacles. These often represent "choke points" along a wildlife corridor.

It is important to note that, within a large open space area in which there are few or no man-made or naturally occurring physical constraints to wildlife movement, wildlife corridors, as defined above, may not yet exist. Given an open space area that is both large enough to maintain viable populations of species and provide a variety of travel routes (canyons, ridgelines, trails, riverbeds, and others), wildlife will use these "local" routes while searching for food, water, shelter, and mates, and will not need to cross into other large open space areas. Based on their size, location, vegetative composition, and availability of food, some of these movement areas (e.g., large drainages and canyons) are used for longer lengths of time and serve as source areas for food, water, and cover, particularly for small and medium-sized animals. This is especially true if the travel route is within a large open space area. However, once open space areas become constrained and/or fragmented as a result of urban development or construction of physical obstacles such as roads and highways, remaining

landscape features or travel routes that connect the larger open space areas can "become" corridors, as long as they provide adequate space, cover, food, and water, and do not contain obstacles or distractions (manmade noise, lighting) that would generally hinder wildlife movement.

3.2.4.2 CAMP PENDLETON WILDLIFE CORRIDORS

Many of the open space areas within and adjacent to Camp Pendleton to the northeast within the Cleveland National Forest are generally large enough to support varied and abundant resident plant and wildlife populations and to provide for unrestricted movement between the Base and adjacent open space lands. The large habitat areas of the Base also allow generally unrestricted access to the north, toward permanently designated open space areas of the Cleveland National Forest, Casper's Wilderness Park, O'Neill Regional Park, Rancho Mission Viejo Land Conservancy, and Thomas F. Riley Wilderness Park (formerly called Wagon Wheel Regional Park).

While there are likely a number of preferred travel routes and landscape features that larger and more mobile wildlife species may use to move within and between permanent open space areas, wildlife "corridors," have not been formally studied and documented within the open space habitat areas surrounding the Base, nor on Camp Pendleton. This is essentially because these Camp Pendleton and adjacent, permanently designated open space areas (parks and national forests) have generally not been constrained or reduced to the point of artificially creating, or necessitating, development of wildlife corridors. However, with current and proposed future development planned for many of the areas between the parks, national forests, Camp Pendleton and other permanently designated open space areas, any remaining landscape linkages could "become" wildlife corridors in the near future.

Wildlife movement on Base is facilitated by the fact that Camp Pendleton contains several watersheds and several small coastal drainages. Although water flows are intermittent across these drainages, they support abundant riparian woodland, scrub, and wetland vegetation communities within the floodplain areas, and coastal sage, chaparral or grassland vegetation on canyon slopes and along ridgelines. These areas provide food and cover for many wildlife species on the Base in addition to facilitating wildlife movement basewide. Potential east-west wildlife movement on Camp Pendleton can occur along the Santa Margarita River, and Las Flores, Aliso, and San Onofre canyons, portions of the San Mateo and San Luis Rey Rivers, and along several small coastal drainages. San Onofre Creek, San Mateo Creek, and the Santa Margarita River offer the best direct connection for wildlife, albeit highly restricted by the I-5 corridor, to the beaches and coastal bluffs of Camp Pendleton.

Like most of southern California's streams and river systems, water flows are only intermittent in most of the drainages on Camp Pendleton. Drainages, like the Santa Margarita, provide food and cover for many wildlife species on Base, and facilitate wildlife movement from coastal and foothill areas eastward to the Santa Ana Mountains in the Cleveland National Forest.

Potential north-south wildlife movement occurs on Camp Pendleton through the inland

mountains situated along the eastern half of the base, and those of the coastal belt located just east of the I-5 corridor. Other potential north-south wildlife movement on Camp Pendleton may include the along the beaches, coastal benches/bluffs, and foothills that are, for the most part, unconstrained by development and other artificial barriers.

Urban development over the past 30 years has severely reduced the expanse of once common native vegetation and wildlife habitats that existed north of Camp Pendleton in the foothills and valleys situated between the coastal and the steep terrain of the Cleveland National Forest. Many remaining vegetation communities have become fragmented, isolated and constrained by regional development. This trend is expected to continue and even accelerate, given regional population projections unless regional conservation planning efforts and land set-asides are established.

At present, regional conservation efforts are focused on crafting remaining open space areas into a reserve system that is expected to provide larger, core biological areas and both landscape linkages and wildlife corridors that connect onto Base lands. The central/coastal Orange County NCCP plan, approved in 1996, set aside more than 37,000 acres of open space lands as mitigation for anticipated future development in the region. The southern Orange County NCCP plan, which is still undergoing development and approval by region stakeholders, is also expected to set aside tens of thousands of acres of open space lands as mitigation for anticipated future development. Upon final approval of a collective reserve design for southern Orange County, these lands will be incorporated into a regional network of wildlife preserves and mitigation set-asides. These lands are expected to provide needed landscape linkages necessary to help ensure Camp Pendleton's existing and future open space lands and natural resource assets do not become isolated as an island within a sea of fragmented, patchy vegetation, sparse open space parks and urban sprawl. It is assumed that a majority of the remaining lands situated outside planned wildlife reserves and mitigation set-asides in southern Orange County, from the coast to the Santa Ana Mountains, will be developed for residential, commercial or industrial uses.

While it is acknowledged that military development trends on Base over the past 60 years pose some modest constraint to existing wildlife movement, selected portions of the Base's landscape have become increasingly constrained over the years by nonmilitary entities development actions on Base lands (e.g., I-5, railroad). Such development not only acts to inhibit wildlife movement both across, and to and from, selected portions of Camp Pendleton, it constrains military training activities, and jeopardizes the military readiness capability of the Base.

South of Camp Pendleton, open space lands are not being consumed quite as rapidly in comparison to those to the north. Remaining open space lands, however, are considered small, highly fragmented parcels, with little native vegetation. Many of these parcels are in an urban setting and are severely limited in their capacity to support movement of any kind by native wildlife species, beyond very localized movement.

The nearest available open space areas to the south that are contiguous with Camp Pendleton are situated immediately adjacent to the Base's southern boundary along the floodplain and adjacent slopes of the San Luis Rey River. Larger open space areas south of the Base exist

within the central part of the City of Oceanside, north of Oceanside Blvd. and east of El Camino Real. This site, however, is a former agricultural field that contains little in the way of native vegetation. Additional open space lands exist further south, along State Route 78 and Buena Vista Creek, and further south in the northeastern and southeastern portions of the City of Carlsbad. The only potential direct linkage corridor between Camp Pendleton and those isolated parcels to the south is provided by the San Diego Gas & Electric's transmission corridor easement, much of which is highly disturbed, cleared or heavily influenced by edge effects from nearby urban developments. The Draft Oceanside Subarea Plan to the MHCP proposes a "stepping-stone" landscape linkage to allow dispersal north-south across Oceanside between Camp Pendleton and north Carlsbad for coastal sage scrub bird species.